COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

FOR CONSIDERATION BY NSF ORGANIZATION UNIT(S)
(Indicate the most specific unit known, i.e., program, div., ion, etc.)

Due Institution-wide Reform Initiative

FOR NSF USE ONLY
NSF PROPOSAL NUMBER

PROGRAM ANNOUNCEMENT/SOLICITATION NO./CLOSING DATE/If not in response to a program announcement/solicitation enter GPG, NSF 95-27

DATE RECEIVED	NUMBER OF COPIES	DIVISION ASSIGNED	FUND CODE	FILE LOCATION

EMPLOYER IDENTIFICATION NUMBER (EIN) OR TAXPAYER IDENTIFICATION NUMBER (TIN)
34-1011998

SHOW PREVIOUS AWARD NO. IF THIS IS
☐ A RENEWAL OR
☐ AN ACCOMPLISHMENT-BASED RENEWAL

IS THIS PROPOSAL BEING SUBMITTED TO ANOTHER FEDERA AGENCY? YES ☐ NO ☒ IF YES, LIST ACRONYM(S)

NAME OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE
Youngstown State University

AWARDEE ORGANIZATION CODE (IF KNOWN)

ADDRESS OF AWARDEE ORGANIZATION, INCLUDING ZIP CODE
Office of Grants & Sponsored Programs
Youngstown State University
One University Plaza
Youngstown, OH 44555-2378

NAME OF PERFORMING ORGANIZATION, IF DIFFERENT FROM ABOVE

PERFORMING ORGANIZATION CODE (IF KNOWN)

ADDRESS OF PERFORMING ORGANIZATION, IF DIFFERENT, INCLUDING ZIP CODE

IS AWARDEE ORGANIZATION (Check All That Apply)
(See GPG II.D.1 For Definitions) ☐ FOR-PROFIT ORGANIZATION ☐ SMALL BUSINESS ☐ MINORITY BUSINESS ☐ WOMAN-OWNED BUSINESS

TITLE OF PROPOSED PROJECT
Investigative Approaches in the Natural Sciences

REQUESTED AMOUNT	PROPOSED DURATION (1-60 MONTHS)	REQUESTED STARTING DATE
$ 183,579	36 months	July 1, 1998

CHECK APPROPRIATE BOX(ES) IF THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW

☐ BEGINNING INVESTIGATOR (GPG I.A.3)
☐ DISCLOSURE OF LOBBYING ACTIVITIES (GPG II.D.1)
☐ PROPRIETARY & PRIVILEGED INFORMATION (GPG II.D.10)
☐ NATIONAL ENVIRONMENTAL POLICY ACT (GPG II.D.10)
☐ HISTORIC PLACES (GPG II.D.10)
☐ SMALL GRANT FOR EXPLOR. RESEARCH (SGER) (GPG II.D.12)
☒ GROUP PROPOSAL (GPG II.D.12)
☐ VERTEBRATE ANIMALS (GPG II.D.12) IACUC App. Date _____
☐ HUMAN SUBJECTS (GPG II.D.12)
Exemption Subsection ____ or IRB App. Date _____
☐ INTERNATIONAL COOPERATIVE ACTIVITIES: COUNTRY/COUNTRIES _____
☐ FACILITATION FOR SCIENTISTS/ENGINEERS WITH DISABILITIES (GPG V.G.)
☐ RESEARCH OPPORTUNITY AWARD (GPG V.H)

PI/PD DEPARTMENT
Biological Sciences

PI/PD FAX NUMBER
(330) 742-1483

PI/PD POSTAL ADDRESS
Dr. John D. Usis
Youngstown State University
Youngstown, OH 44555-2378

NAMES (TYPED)	Social Security No.*	High Degree, Yr	Telephone Number	Electronic Mail Address
PI/PD NAME John D. Usis, Ph.D.	555-70-7704	Ph.D. 1990	(330)742-3604	
CO-PI/PD				
CO-PI/PD				
CO-PI/PD				
CO-PI/PD				

NOTE: THE FULLY SIGNED CERTIFICATION PAGE MUST BE SUBMITTED IMMEDIATELY FOLLOWING THIS COVER SHEET

*SUBMISSION OF SOCIAL SECURITY NUMBERS IS VOLUNTARY AND WILL NOT AFFECT THE ORGANIZATION'S ELIGIBILITY FOR AN AWARD. HOWEVER, THEY ARE AN INTEGRAL PART OF THE NSF INFORMATION SYSTEM AND ASSIST IN PROCESSING THE PROPOSAL. SSN SOLICITED UNDER NSF ACT OF 1950, AS AMENDED

Project summary:

This proposal addresses the problem of science education reform for non-science majors, as part of larger general education and pedagogical reforms already underway at Youngstown State University. The current general education requirements at YSU specify only a certain number of hours in science, with no attention to the connection between the objectives of general science education and the choices of content and methods of the courses available to satisfy the science requirement. The objectives of the science reform are to ensure that all graduates of Youngstown State have an understanding of the scientific method, the ability to formulate and test hypotheses, an awareness of the relationships between science, technology and society, and an understanding of the natural environment and the processes that shape it. General science education should provide students with critical thinking and analysis tools, basic knowledge, and investigative skills needed for career preparation as well as to make informed decisions about scientific and technological issues that affect their personal lives and their communities. To achieve these objectives, the science departments will fill a gap in their current general education offerings by creating new investigative laboratory courses for non-science majors in each of the disciplines, and by reforming existing non-laboratory science and mathematics courses. Each of the new collaborative laboratory courses will share the common goals of providing students with experience in formulating and testing hypotheses, collecting and analyzing data, critical thinking, and working in cooperative groups to solve problems through their active participation in a scientific investigation. The other non-laboratory courses will be restructured to provide meaningful choices for general education that complement the laboratory courses with relevant and appropriate content, and additional training in critical thinking and problem solving.

TABLE OF CONTENTS

For font size and page formatting specifications, see GPG Section II.C.

*Proposers may select any numbering mechanism for the proposal, however, the entire proposal must be paginated. Complete both columns only if the proposal is numbered consecutively.

I. Project Narrative

A. Results from prior NSF support

In the past three years, Youngstown State University has implemented a number of reforms in science education, including seven projects supported by NSF grants: i) an X-ray Diffractometer (DMR RUI DUE 9403889), ii) a Gas Chromatograph-Mass Spectrometer (ILI-IP DUE 9551683), iii) an Environmental Chemistry Lab (ILI-IP DUE 9751151), iv) a Portable Mechanics Physics Lab (ILI-IP DUE-9552374), v) an Environmental Investigative Laboratory (ILI-IP DUE 9552347), vi) Enhancing Undergraduate Education Through Mossbauer Spectroscopy (ILI-IP DUE-9751236) and vii) Subsurface Investigations: An Integration Of Geological Principles (ILI DUE-9351871).

i. NSF RUI DUE 9403889 X-ray diffractometer ($71,199, matched by over $200,000. Duration: 1994-96): Funds from this grant were used to purchase 2 new Siemens P4 X-ray diffractometers, a low temperature setup, a multi-wire area detector, and a number of SGI and PC workstations for data processing. Acquisition of this instrumentation has allowed full integration of advanced diffraction methods into the Chemistry curriculum. A new 3 quarter hour course, Chemistry 832 "Solid State Structural Methods," that teaches crystallography to groups of about ten Chemistry, Geology, and Engineering majors, will be offered for the third time this year. The first offering of this course is resulting in several papers with undergraduate co-authors [Hunter et. al., 1997e, 1997g and 1997h and Cashman et. al., 1997]. A student laboratory manual (X-Ray Structure Determination by SHELXTL: A Beginners Introduction [Hunter, 1997c]) was written and is now being evaluated by crystallographers in about a dozen universities. This instrumentation has also allowed powder diffraction and single crystal diffraction methods to be integrated into three other upper level Chemistry courses. In addition, a new graduate course on advanced crystallographic methods, Chemistry 993, as been developed and will be offered for the first time this year. Further detail on these courses and related

curricular innovations can be found in upcoming publications in the *Journal of Chemical Education* [Hunter, et. al., 1997a, 1997b, 1997d and 1997f]. In addition, this instrumentation has contributed to chemical, materials, and geological research at YSU and three collaborating universities.

ii. NSF ILI-IP DUE-95-51683 GC-MS ($34,450, matched by about $40,000 from YSU. Duration: 1995-96): This grant was used to purchase a Finnigan 1020 Gas Chromatograph-Mass Spectrometer. This instrument has been fully integrated into senior level organic synthesis, organic analysis, and inorganic lab courses serving about 50 students a year. These advanced courses operate on a largely collaborative learning, discovery-oriented model. It is also integrated into our sophomore organic lecture sequence which serves approximately 200 students each quarter, primarily from the natural sciences, engineering, and pre-medicine, where it has facilitated an ongoing conversion to a more research oriented laboratory approach.

iii. NSF ILI-IP DUE 9751151 Environmental Chemistry lab ($78,350 matched by $78,350 from YSU. Duration: 1997-98): Funds from this grant have recently been used to purchase several items of equipment needed in the development of an integrated science course that exposes students to "real-life" techniques and procedures used in Phase I and Phase II property assessments of brownfields. This course will be offered for the first time during the Fall of 1998. Brownfields are previously used industrial sites that are presently not being fully utilized due to uncertainties in the cost of environmental remediation of the sites. The course is intended for students in environmental studies, chemistry, civil and environmental engineering, biology and geology, from Youngstown State University and ten other colleges in the region. The course will present in an integrated format the dependence of an analysis protocol on size, type of sample collected, type of container and preservatives, collection procedure and method of sample preparation, and should provide students with an increased appreciation of the

interconnections between what are often presented as independent functions. Equipment purchased includes a CEM Microwave Oven, a Varian Graphite Furnace Atomic Absorption Spectrometer, and a Varian Gas Chromatograph-Mass Spectrometer.

iv. DUE-9552374 Portable Mechanics Physics Lab ($20,000, matched by $25,038 from YSU. Duration: 1995-97): This grant was used to purchase computing equipment and portable data collection equipment, and enabled the Department of Physics and Astronomy to reform its introductory mechanics laboratories (Physics 501L and 510L) for natural science majors. In these restructured courses, the number of experiments to be performed in the ten-week quarter has been reduced from nine to three. Each experiment focuses on one of the three fundamental approaches to mechanics: force and motion, energy, and momentum. Through a computer-assisted assessment, students are now able to target their own initial conceptions of each topic and decide how best to test their conceptions using portable data collection hardware funded through this grant. Over an extended three week period, students perform their tests using subjects and environments familiar from everyday experience, and report back to the laboratory to analyze results and repeat the assessment of their conceptions, comparing initial conceptions with final conclusions. The final NSF report on this effort will be submitted by December, 1997.

v. Environmental Investigative Laboratory NSF-ILI DUE-9552347 ($25,000, matched by $46,300 from YSU. Duration: 1995 to 1997 with a one year extension to 1998.) Funds from this ILI grant were used to develop the laboratory for Fundamentals of Environmental Studies, the introductory two-quarter course sequence in the core curriculum of the Environmental Studies program. The course features a "discovery" type laboratory that emphasizes the scientific method, data management, understanding of accuracy, precision and error, critical thinking, teamwork, and communication skills. The course was first offered in

Winter 1996, enrolling a total of 50 students, divided among two sections. An Investigative Laboratory Manual was also developed for the course, and includes exercises on the scientific method, team research and student-initiated projects. Equipment purchased with funds provided by this grant include: 6 analytical balances, 6 drying ovens, 6 spectrophotometers, 6 dissolved oxygen meters, 6 muffle furnaces, 6 centrifuges with rotors and buckets, and 6 computers.

vi. NSF ILI-IP DUE-9751236 Enhancing Undergraduate Education through Mossbauer Spectroscopy ($10,000, matched by $10,000 from YSU. Duration: 7/97 - 6/99): This grant is being used to purchase a Mossbauer spectrometer for a series of student experiments being developed for inclusion in the Physics lab curriculum, including a focus on: 1) Observation of quantum uncertainty through measurements of lifetime and line shape for the 14.4-keV level in ^{57}Fe; 2) Observation of changes in the nuclear charge distribution through measurement of the isomer shift; 3) Observation of nuclear Zeeman splitting of the 14.4-keV and ground states of ^{57}Fe and measurement of the internal hyperfine field strength from the level splitting; 4) Observation of quantum uncertainty through detection of virtual states produced by RF/gamma-ray multiphoton absorption. These experiments are expected to strengthen the upper level physics curriculum, particularly in quantum mechanics and nuclear physics. The emphasis of this project is primarily conceptual to enable students to observe directly the concrete results of new ideas Also, Mossbauer experiments will be used in cooperation with the Departments of Chemistry and Geology to expose students to the use of this spectroscopic technique in characterizing the chemical composition of materials.

vii. NSF ILI DUE-9351871 Subsurface Investigations: An Integration Of Geological Principles (1993-96, $46,430, match by $46,430). This project provided equipment essential to the development of a new introductory Geology course following the investigative model that was first taught in 1995 to 22 students. This course, Subsurface Investigations, introduces

students to a wide variety of subsurface investigative techniques (including refraction seismology, earth resistivity, bore hole data, outcrops, geochemical data, etc.) which are used in an integrative fashion to solve applied problems in Geology [Dick, 1995]. The equipment is also used in several existing upper level geology courses.

B. Problem or question.

Youngstown State University is a state-supported metropolitan university serving 12,800 undergraduate and 1,100 graduate students. The majority of students commute to campus from a five county region in Northeastern Ohio and Western Pennsylvania, most of whom are working full or part time in addition to attending school. YSU is committed to broad academic access through open admission for all Ohio high school graduates and serves a diverse population of traditional and non-traditional students, many of whom are the first in their family to attend college. While predominantly an undergraduate institution, the University offers a number of MS programs, including Biology, Chemistry, Mathematics and some Engineering disciplines, and a Ph.D. in Educational Administration. Teaching is central to the mission of the University, which is committed to maintaining a learning environment that enhances the academic potential of all its students. Support for the integration of teaching, scholarship and service has created an environment that fosters curricular and pedagogical reforms that emphasize the connections between the classroom and society and the workplace.

Youngstown State University has begun the process of reviewing and reforming its general education science requirements as part of larger general education and pedagogical reforms. The current general education requirements at YSU specify only a certain number of hours in science, with no attention to the connection between the objectives of general science education and the choices of content and methods of the courses available to satisfy the science requirement.

There are currently at least 32 courses that can be used at Youngstown State to satisfy the University's general education requirement in the sciences. Most of these courses are broad surveys, while others are very narrowly focused. Some courses, such as *Chemistry for the Allied Health Sciences* or *Geology for Engineers*, can be used towards the general requirement but are clearly not intended for general audiences. Thus, the amount and level of preparation in science achieved by graduating students varies widely and, for most students, is inadequate for life in the twenty-first century.

Typically, non-science majors at Youngstown State University, as at other schools, take only the minimum number of science courses required for graduation. The courses that they do take are typically survey courses without laboratories. These courses attempt to present a broad range of material that is not always perceived as relevant to the students, and they provide no opportunities for students to engage in scientific activities. Our current introductory science laboratories tend to be sets of unrelated experiments that survey a wide range of topics and techniques. In general they omit, or teach only in the abstract, some of the most important aspects of scientific research, including preliminary analysis of a problem, design of methods for probing the problem, group interaction and discipline, and discovery by the student. Introductory laboratories have traditionally required students to repeat a different "experiment" each session, step-by-step as laid out in a laboratory manual, i.e. "cook-book" science. Through these "experiments" students at best only survey a few examples of the application of specific principles and lab techniques, with little or no understanding of the process of scientific discovery [Aarons, 1990, Reddish, 1994, Tobias, 1990].

The problems faced by Youngstown State in trying to address students' needs in general education are certainly not atypical. Indeed, the aims of higher education are being re-examined nationwide. It is widely acknowledged that there is an urgent need for all Americans to improve their scientific literacy and to have a solid foundation in science and technology. It is also generally accepted that, by and large, colleges and universities do not provide adequate

preparation in either science content or methods to the vast majority of undergraduates, the non-science majors. Courses that provide factual information without much societal context, teaching methodologies that emphasize memorization over thoughtful inquiry, and passive rather than active or collaborative learning are frequently cited approaches that, in the past, have proven to be less than ideally effective. A number of recent national studies support this view, including:

- All undergraduates must attain a higher level of competence in science, mathematics, engineering and technology (Advisory Committee of NSF, 1996).
- Every student should be presented an opportunity to understand what science is, and is not, and to be involved in some way in scientific *inquiry*, not just a "hands-on" experience (Advisory Committee of NSF, 1996).
- The welfare of the nation and the individual will be improved when all citizens have sufficient understanding of science to make sound personal, civic and professional decisions. Dramatic reform of undergraduate science education is of critical concern (Project on Liberal Education and the Sciences, AAAS, 1990).
- Our ability to make everyday decisions wisely is diminished when we do not comprehend scientific principles (50 Hours: A Core Curriculum for College Students: National Endowment for the Humanities, 1989).
- Because many of the problems that humans now face are global, rather than provincial, in nature, scientific literacy must be the goal for everyone, not just the practitioners. (Science for All Americans - Project 2061, 1989)

Youngstown State University faces several challenges in revising its general education requirements. A core curriculum model, in which all students take the same general education courses is not feasible for several reasons. There is a wide variety in the background and preparedness of students who attend YSU, and these differences must be addressed. Because of the large number of students to be educated, the resources needed for general education cannot be concentrated in a few courses or departments. In addition, so many of our students have to

balance school and work schedules that lock-step curriculum models are not workable. The science requirements at Youngstown State are being revised within the constraints of a larger general education model that provides students with choices and flexibility in the courses that they take, along with when they are offered. Finally, no general education program can claim to provide students with all of the information that they will need throughout their lives and careers. Because of this, general education must provide students with experiences to develop critical thinking skills and tools for accessing information and understandings to nurture lifelong learning.

C. Proposed project.

1. Goals and objectives

The current general education reform at Youngstown State University began three years ago. Thus far, the academic community at the University has developed and approved a set of 13 goals that general education should achieve. Each goal is not intended to translate into one course. Rather, any general education course must meet a number of goals. The following list represents the subset of goals that general education sciences courses should address. In particular, all students graduating from Youngstown State University should be able to:

- understand and use the scientific method, including being able to form and test hypotheses and evaluate results.
- realize the evolving interrelationships among science, technology and society
- understand and appreciate the natural environment and the processes that shape it.
- write and speak effectively.
- acquire, process, and present quantitative and qualitative information using the most appropriate technologies, including computers.

- reason critically, both individually and collaboratively, draw sound conclusions from information, ideas, and interpretations gathered from various sources and disciplines, and apply those conclusions to one's life and society.
- comprehend mathematical concepts and reason mathematically in both abstract and applied contexts.

In view of the goals listed above, the science programs at Youngstown State University (Biological Sciences, Chemistry, Environmental Studies, Geography, Geology, Mathematics & Statistics, Physics & Astronomy) have established the following specific objectives:

- Provide at least one required laboratory science course to be selected from any of the science departments
- Provide *all* students with the opportunity to learn what science is, and is not, by participating in scientific inquiry, related where appropriate to faculty research interests
- Encourage and nurture further study in science
- Include interdisciplinary themes and projects in introductory courses to foster a sense of the connections among the sciences
- Provide meaningful choices for general education that complement the laboratory courses with relevant and appropriate content, additional training in critical thinking and problem solving, and exposure to the connections between science, technology and society.
- Provide students with appropriate mathematical and statistical analysis skills, either in separate courses or in the context of applied problems in science courses.

2. Procedures and methods

To achieve the goals and objectives outlined above, the science departments at YSU propose to establish a new coherent investigative laboratory course at the introductory level for

non-science majors, to review both the content and pedagogy of existing general science offerings, and to revise these courses as necessary.

Individual sections of the new laboratory course will be offered by each of the sciences. While the content in different sections will emphasize the subject matter of a particular area of inquiry (some of which are by nature interdisciplinary), all sections will provide students with the principles of scientific inquiry and investigation and how they are used in practice to solve problems in laboratory settings. The new course is being designed and coordinated by an interdisciplinary team including faculty from all of the sciences not only to foster integration among the sciences but also to emphasize "context-rich" activities with applications to either everyday experience and/or to topics of current interest in the broader community. The instructional methods to be used will emphasize a discovery approach to acquiring scientific knowledge while inculcating students with the needed "habits of mind" appropriate for scientific investigations [Aarons, 1990, McDermott, 1991, Reif, 1995, Tobias, 1990].

This new investigative laboratory course is only one component of our revised science curriculum. The other is the one or two additional science courses, which will not necessarily have a laboratory component, that students will be required to take to fully meet our goals. The team established under this proposal will work closely with each of the science departments to help them review existing offerings and decide whether these are appropriate as is, whether they will require substantial modification, and/or whether new courses will be needed. It is expected that many of the more specialized courses, perhaps with modifications, will be retained for their science and technology majors who are their primary audiences but not for general education. Others will require substantial modification in light of our new science education goals and the participation of all undergraduates in the discovery oriented lab courses. We have already begun this process of revision, for example, with the introductory Chemistry course for non-science and technology majors, *Chemistry in Modern Living*. This course now uses the text book *Chemistry in Context* which has a strong environmental focus. The course emphasizes group problem

solving, methods of scientific problem solving, thought experiments, and writing intensive approaches to chemistry. The new investigative laboratory and the other revised science courses will all seek to improve students' verbal and written communication skills, promote their use of computers and other technologies, and foster collaborative learning.

Faculty from the Department of Mathematics and Statistics will be fully involved in this reform effort. The mathematical and statistical skills needed by students in the general education science courses will be assessed so that one or more appropriate prerequisite or corequisite mathematics courses can be identified and revised as needed. Additionally, the general education goals for mathematical literacy will be implemented. Faculty will investigate how such mathematical content can best be integrated into the general education science lecture and lab courses so that students revisit relevant mathematical principles in an appropriate context and with relevant examples. It is clear that all students need some exposure to either mathematical models or statistical data analysis, if not both, and that this background would be much more beneficial to students than a traditional college algebra course.

This general education reform will be built upon the successful reforms for majors in Chemistry, Physics, Geology, and Environmental Studies already described in the section on prior NSF support, as well as additional reforms in Chemistry, Biological Sciences, Geology, and Physics & Astronomy that will be described in detail below. As is the case in the reformed courses for majors, the proposed introductory laboratory course will engage students in guided-inquiry approaches and introduce them to scientific methods for solving conceptual or applied problems. In addition, the new courses will include interdisciplinary and integrative content, a new emphasis on student writing, collaborative learning [Heller et. al., 1992a and 1992b, Mazur, 1997], and active learning approaches.

3. Specific lessons, experiments, student projects, course work, new modes of instruction that will be developed, teaching methods employed:

Considerable work is already underway within individual science departments at YSU to revitalize key introductory and advanced courses in ways that address the goals of general education reform previously outlined above. With a few notable exceptions, however, these efforts have been isolated within individual disciplines and, in most cases, have been in courses taken only by science majors. A primary component of the proposed work will be the development and implementation of introductory laboratory courses for non-science majors that reflect the best of the current reform efforts among all the science disciplines involved.

In this section we describe in detail, discipline by discipline, the planned reforms to be incorporated into the new introductory laboratory course. The course descriptions which follow demonstrate the breadth of ideas that we are incorporating into the new multi-section non-major course. At this time, each discipline can be seen to have emphasized a somewhat different approach. One significant goal of this project then will be to learn from each other the different innovations and approaches that are possible and the advantages and pitfalls characteristic of each. To do this, we will use some of the resources provided for development and testing of this course to promote cross-disciplinary team implementation of the pilot sections. Faculty from different departments will explore each other's innovations under the direction of the project investigators. By working together on these efforts, we will modify the sections as they are developed to incorporate the best of the new approaches from each. Thus, the reform will be broad-based within the institution not just from the perspective of the students affected, but also from the perspective of the instructors involved who will substantially broaden their repertoire of instructional techniques.

Regardless of discipline, all of the introductory laboratory courses will share the following common goals for students who take them:

- The ability to demonstrate critical thinking about a problem.

- Being able to suggest solutions to a problem.
- Finding ways to test whether a solution is correct through experiment.
- Accurately recording data with a variety of collection techniques.
- Acquiring knowledge on data interpretation and analysis skills.
- Understanding the recursive nature of scientific inquiry as new discoveries guide further investigations and suggest new models.
- Learning how to work in cooperative teams to accomplish common goals.
- Learning how to integrate and critically compare original research results with related results drawn from the literature.
- Learning how to present the results of a research project in a professional fashion in written and/or oral formats.

While YSU is currently on the quarter system, a conversion to semesters is being planned, and is expected to be in place by the time the general education reform is complete. Therefore, the proposed new courses are being designed for a 15-week semester.

Investigative Approaches in the Biological Sciences: The Department of Biological Sciences has revised its introductory laboratory course for majors (Biology 509), and will take the same approach in redesigning the general biology course for non-majors.. Freshman students now entering as biology majors or students of other programs which require Biology 509 as a prerequisite for their admission now take a new investigative laboratory course. The major objective in restructuring the course was to get students thinking about a problem, analyzing variables, suggesting solutions, and then finding ways to test whether a solution is true. We wanted a course that truly developed students' abilities to utilize the scientific method, test hypotheses, and make predictions based upon these hypotheses. This outcome was felt to be far more important than an ability to fill in worksheets on "canned" exercises or take practicals/quizzes. The new course was designed specifically to incorporate computer

simulations and modeling for each experiment performed to stimulate a deeper probing of the underlying nature in the assigned exercise. Students are required to complete each experiment and collect data under prescribed conditions. They then must modify that experiment by changing variables of their own choosing, collecting new data, formulating hypotheses and making new predictions based upon their hypotheses. Students are required to write organized scientific reports that explain their observations, state clearly their findings, and offer statistical support for accepting or rejecting Null or Alternative hypotheses. A completely new laboratory text has been written specifically for Biology 509 and will be adapted for use in the new course as well.

Typical examples of laboratory experiments that will be developed for non-majors include study of:

- rates of diffusion across selectively permeable membranes
- rates of cellular respiration in yeast under varying environmental conditions
- rates of photosynthesis at differing light intensity for selected competitive plant species
- measurements of genetic variability in populations of differing size distributions.

Investigative Approaches in Chemistry: The Department of Chemistry has revised most of its upper level courses to a more research-oriented collaborative model over the last few years. The experience gained will be applied to the new general education course. The integrated lecture and lab course, *Investigative Approaches in Chemistry: Chemistry 100*, course will meet one to two hours per week for lecture/discussion and three to six hours per week for laboratory over the semester. It will come in several "versions," each of which will *immerse the students in chemical research* so that they can learn what science is, what a scientist does, and how science actually solves problems *by doing science.* Thus, rather than hearing about how science is done or about its results the students will learn about it at the direct experiential level. In fact, current

empirical research [Tobias, 1990] clearly show that this is the best way to both learn the material and "turn the students on."

Although the themes of each of the sections will be different, their structures will all be similar. At the start of the semester the classes will be given a set of questions or challenges that will require original research to answer. Our central theme is that rather than being survey courses these classes will involve studying one or two relatively narrow topics in considerable detail (i.e. approximately up to the level of a senior level course in some cases) with a strong laboratory research component. In our experience, by focusing on a much narrower topic than is typical in general science courses, the student can attain sufficient depth to participate in realistic research problems.

This course structure is growing in popularity for courses for science majors, especially at upper levels. Indeed, most of our upper level labs follow this model or are converting to it. In general, however, there is little experience with using this model for large classes of non-science and non-engineering majors. In the lecture/discussion sections (which will typically include 40 to 70 students), the students will develop their background "theoretical" knowledge base in the general area of their projects. This will be done by a combination of formal lectures by the faculty "facilitator/coach," extensive group discussion and problem solving sessions, and computer-based instructional and literature research sessions. These large lecture/discussion sections will each have two or three associated laboratory sections in which students work in collaborative groups of 4 to 6 students with the assistance of a faculty facilitator/coach and at least one undergraduate peer assistant. Each of these lab groups of 4 to 6 students will work on one or two projects for the whole semester to produce a project. These reports will be shared with peers and posted on the course's web page. In the lab component, groups will meet with the instructor to review their plans for the next week's work, order necessary supplies, equipment and references, and make desirable modifications in the project as do real chemical research teams.

Typical examples of proposed group projects include:

- the preparation of the most intensely colored and color fast dye possible (i.e. by aniline dye chemistry)
- the preparation of the strongest plastic fiber possible (i.e. by condensation and addition polymerization and/or recycling)
- the changes in a model environment (i.e. the aqueous chemistry and microbial life in a open tank)
- the optimization of a fermentation process
- the evaluation of the pollution at a brownfield industrial site
- synthesis of an adhesive and its use to prepare a truss out of glue and spaghetti able to bear the maximum possible weight

Investigative Approaches in Weather (Geography): At YSU weather and climate are subject areas that are addressed in Geography Department courses. These topics have broad and practical appeal to students. Life experiences teach everyone something about the atmosphere and weather so that the study of meteorology is an effective vehicle to learn about science. Furthermore, weather impacts all sectors of society (e.g., agriculture, transportation, insurance, future commodity prices) and atmospheric science is involved in many of today's major environmental issues (e.g., global climate change, acid deposition, air pollution, water resources, El Niño). In studying the weather, students apply concepts and principles drawn from other scientific disciplines including, for example, physics (e.g., energy transfers, forces of motion), chemistry (e.g., stratospheric ozone depletion) and biology (e.g., the influence of tropical rain forests on precipitation and temperature). There are links between science and technology (e.g., weather satellites, the Internet) and the societal implications of the science can be dramatically demonstrated (e.g., hazardous weather systems).

To address the science education goals of the university's new general education requirements, the Geography Department proposes to change its present non-lab weather class to an inquiry-based laboratory-oriented course emphasizing critical thinking and a hands-on approach that incorporates real-time weather data. The students will conduct or design experiments that demonstrate or test the validity of basic laws and principles governing atmospheric processes and associated weather phenomena and events. Students, individually or as teams, will be assigned to download meteorological products from the Internet, analyze data, and report on their scientific meaning and significance. As much as possible, scientific principles will be linked to events unfolding in the current national and local weather pictures.

Students will monitor weather as it is happening, collecting and interpreting real-time weather data, maps and charts, and satellite and radar images. They will then use this information both to illustrate the atmospheric concepts and principles under discussion and to forecast future weather conditions. Selected exercises will require students to hypothesize about current atmospheric conditions or historic weather events and then collect and analyze actual data to confirm or deny their hypotheses. Other investigations may be designed to illustrate the fact that atmospheric variables are intimately related to each other, and that changes in one variable typically causes changes in other variables, and hence, changes in the weather. Additional problem sets may require students to determine why a severe weather event occurred at one time but not at another, even though the atmospheric conditions may have seemed similar.

Other student experiments and problems may involve such topics as:

- weather statistics
- the electromagnetic spectrum & interpreting weather satellite images
- surface temperatures as related to cover and clouds
- gas laws and adiabatic temperature changes
- experiments in forces of earth and atmospheric motion.

The Geography PI is the local implementer of a $5 million national K-12 teacher enhancement project funded by a NSF grant (No. ESI-9453205) and awarded to the American Meteorological Society. Over a five year period under this grant, *The DataStreme Project: Teacher Enhancement through the Use of Current Environmental Data Across the Curriculum*, 4,100 K-12 teachers will be trained in an intensive course to become weather education resource teachers for their schools. The course is based, in part, on electronically transmitted data streams and learning materials delivered in real time over the Internet. It emphasizes the teaching of integrated science through problem-focused or event-driven investigations of an atmospheric science nature. It is hoped that aspects of this *DataStreme Project* can be adapted for incorporation into the proposed YSU laboratory-oriented weather course.

Investigative Approaches in Geology The Department of Geology has taken several steps during the last few years to revise its curriculum to meet the needs of its majors and of non-science majors under the general education requirements.

The geology major currently is required to complete an introductory course with no laboratory (Physical Geology) as a prerequisite to undertaking a Geology Laboratory course designed to provide hands-on activities complementary to required field experiences. The department recently revised this laboratory course to give greater emphasis to integrating lab and field investigations.

For the non-science major, the department has proposed a Geoscience Laboratory course designed to emphasize problem solving and assessment of case histories in illustrating and examining both the scientific method and geologic principles. The goals of this course include: 1) developing and practicing inquiry processes, and 2) recognizing and evaluating scientific assumptions and claims that may impact lives.

While the framework for both of these are established, clearly there is need to explore how these can be implemented in the most effective manner for their respective audiences, and

how the instruction can be improved using alternative pedagogies and technologies. For example, while the use of computer technology is expanding in geology-major courses, it has only recently been cursorily introduced in entry level courses. In "Investigative Approaches in Geology," students working as collaborative members of teams will be given situational problems and challenged to define relevant issues and questions, to propose approaches of investigation, to acquire and analyze data and to present their findings. Field investigations will be included where appropriate.

Typical examples of topics suitable for investigation include:

- evaluating the processes and impacts of geologic hazards
- analysis of resources such as oil and gas, mineral deposits, and water
- land use applications and consequences, particularly those related to environmental, engineering, or geomorphic responses to activities or conditions

Investigative Approaches in Physics & Astronomy: As was mentioned in the section on prior NSF support, the mechanics laboratories (Physics 501L and 510L) have been revised. While this new approach has only just recently been implemented in our laboratories, initial results appear to be very positive. As hoped, these discovery-based laboratories have demonstrated the following advantages: (1) The approach more closely mirrors the methods of research by allowing time for preliminary analysis of the problem and by requiring the student to decide how best to investigate the problem experimentally. (2) Learning by rote has been de-emphasized and the students have been compelled to think about what is going on, rather than finish and leave as soon as specified data are obtained. (3) Students are more aware of the fundamentals, especially of the three basic approaches to mechanics force and motion, energy, and momentum. (4) Students are now introduced to the design of experiments and to modern methods of data collection and analysis.

The successful revision of the mechanics laboratories will serve as a model for the new laboratory course for non-science majors. Students will focus on three to five extended experiments during the 15 week semester course. The approach to be taken in a representative physics laboratory section is to develop students understanding of the motion of macroscopic bodies by emphasizing the three basic approaches to mechanics, Newton's laws of motion, conservation of momentum, and conservation of energy. We have designed interactive software to probe student understanding of the concepts of kinematics and dynamics. Simple questions direct the students to areas of investigation in which they demonstrate conceptual errors. In consultation with the instructor, students establish and examine a problem that highlights the divergence of their conceptual understanding from the behavior of real objects. In cooperative groups, the students then design and implement tests of a hypothesis to explain the expected behavior. Finally, the student analyzes the results, including a rigorous examination of the consequences of the uncertainties inherent in the methods chosen for testing. We believe that if a student is forced to decide how best to test a model or prediction, that student will of necessity recognize the meaning behind the procedure. The critical question for the student should not be "What do you know?" but rather " How do you know what you know?"

Investigative Approaches in Environmental Studies This course will be concerned with water, soil, or air quality. Students will first answer several basic questions: How do we set the standards for water quality? How is the water quality measured? What determines water quality ? Then, the students will use state water quality standards and determine compliance to these standards at local sites. They will measure dissolved oxygen, total solids, suspended solids, dissolved solids, turbidity, acidity, and chemical contaminants measured by field kits and laboratory determinations. A sampling plan will be developed based on data quality objectives and quality control. This plan will include the use of multiple samples, trip blanks, and spikes. Samples will be taken, analyzed and evaluated to determine compliance with state standards.

4. How proposed innovations will be integrated into institution's academic programs for SMET majors, future K-12 teachers, non-SMET majors

The proposed new science laboratory courses are being designed specifically to address the goals of general education and will therefore impact every single student at the University. The impact will be greatest upon non-science majors who are currently not required to take any laboratory science. The reform of general education in science is part of a larger curricular and pedagogical reform effort at YSU. While the University has identified the goals that general education should meet and is in the process of finalizing a curriculum model, it will be up to individual departments to determine objectives for meeting the goals and then developing appropriate courses that achieve those objectives. Regardless of the detailed final form that the general education structure takes at YSU, the content of general science education and the methods employed to teach it will be determined by the science departments themselves.

A number of science faculty have considerable experience in employing active learning techniques, cooperative learning, and other alternatives to the lecture-only format. One of the goals of this project is to make much wider use of these techniques across the curriculum instead of just in selected courses. Clearly the reforms proposed here cannot be institution-wide if they are implemented only by the principal investigators. Once the courses have been developed and/or revised, the principal investigators will spend a considerable amount of time in planning and conducting training sessions for other faculty, including limited-service faculty and graduate teaching assistants. These training sessions will cover the philosophy of the courses, content to be addressed, pedagogical methods employed, and means of student assessment.

The principal investigators will give careful attention to integrating this science reform with the other general education requirements at YSU. Currently all students are required to take two courses in English composition, a requirement that is not expected to change. The first course in composition will be specified as a prerequisite for the proposed new laboratory course.

This will insure a minimum level of written competence needed for writing laboratory reports and responding to discussion questions about the material presented in the labs. The second English composition course focuses on research writing. Redesigned two years ago with the collaboration of Computer Science and Information Systems faculty, the course emphasizes information gathering techniques using traditional library sources and sources available on-line. Faculty from across the university are invited to teach the research writing course and first receive training in the teaching of writing and the use of the computer as a communication and research tool. The principal investigators will examine the relationship between the general education science courses and this required composition course and use the training provided to strengthen the science writing component of their courses.

Students who do not already have a college-level mathematics course, such as pre-calculus, will be required to take Mathematics 523: Survey of Mathematics, as a prerequisite to the new investigative laboratory. This course has also been revised in light of the new general education goals, and includes a significant component on probability and statistics. This prerequisite will provide students with the mathematical foundation they need for the quantitative aspects of the proposed laboratory course, including data analysis. It should be noted that faculty from the Department of Mathematics & Statistics will be involved in the design of the proposed laboratory courses. It is recognized that a single mathematics course is unlikely to provide students with all of the mathematical background that they will need. Rather than requiring additional mathematics courses, the approach of integrating relevant mathematics into other courses, such as the proposed science courses, seems very promising, and will be developed by the principal investigators.

This grant will help support and extend the current cross department dialog about teaching and learning that has been fostered through the College of Arts and Science "Master Teacher Program" and the College newsletter, *The Art and Science of Teaching*. This conversation has produced the pedagogical and curricular reforms that are occurring throughout

the College as faculty within and across departments come together to plan team-taught courses and discuss how students learn and what students should learn.

5. Project timetable:

Year 1 (1998-1999):

- Evaluation of current YSU reform efforts in biology, chemistry and physics
- Consultation with other institutions that have reformed general education courses
- Formulation of exercises or investigative topics and development of pilot sections of investigative laboratories
- Implementation of pilot sections of the new laboratory courses in several departments (Spring or Summer sessions)
- Begin review of other science courses intended for general education

Year 2 (1999-2000)

- Implement pilot sections of new laboratories; at least one section per term in each science department
- Evaluation of pilot sections by instructors and external reviewers
- Modification of pilot sections by principal investigators
- Development and implementation of training sessions for other faculty
- Full implementation of revised non-laboratory general education science courses

Year 3 (2000-2001)

- Full scale implementation of the new laboratories
- Further evaluation and modification of all general education science courses with an emphasis on optimizing the relationship between the new investigative lab course and the other new science and related non-science courses

6. Expected impact on students, especially women, minorities and disabled persons:

The proposed courses will place great emphasis on active learning techniques, cooperative and collaborative learning, and place more responsibility on the students for their own learning. The faculty at YSU are increasingly aware that students have different learning styles, and the proposed courses are designed to be accessible to a wide variety of students. Indeed, previous research [Tobias, 1990 and Treisman, 1992] indicates that courses that employ pedagogical methods other than lecture-only should be much more effective with students drawn from traditionally under-represented groups in the sciences. Efforts will be made during the regular evaluations of this project to monitor the perceptions of members of under-represented groups so that we can specifically address their needs and interests.

It is recognized that general education courses cannot provide students with all of the factual knowledge needed in their lives and careers. The new and revised courses for general science education are designed to promote critical thinking skills and nurture within students the ability to engage in lifelong learning.

D. Evaluation

The success of the project will be evaluated by the extent to which it impacts student learning in the sciences. Specifically, the project will be assessed as to how well it promotes and encourages:

- increased knowledge about the natural environment
- awareness of the importance of science in society, careers, and personal lives
- greater critical thinking and problem-solving skills in students
- a positive attitude towards science in students
- improved retention rates in general education science courses

A number of activities will be undertaken to attempt to measure the outcomes listed above. Evaluation of the project will include the following components:

- Pre and post tests in science courses that measure students' abilities in critical thinking, problem formulation and solving, experimental design, and data analysis.
- Pre and post test that measure changes in students attitudes towards science and the approaches used in these new labs
- Formal exit interviews with a representative sampling of students to provide increased detail on questions raised by students' written course evaluations
- Tracking of students' performance in other courses taken subsequent to the proposed introductory course
- Exit surveys of graduating students that include questions designed to assess whether the general education goals have been achieved
- Independent review by YSU non-science faculty members who are involved in the General Education reform effort, and/or have background in educational or social science research.
- Independent review by external reviewers with background in science, education and/or social science research.

Two members of the Youngstown State University General Education Task Force have agreed to serve as project evaluators: Dr. William Jenkins, Professor and Chair, Department of History, and Dr. Stephanie Tingley, Professor, Department of English. To assist in the design of appropriate pre and post tests, the principal investigators will draw upon the expertise of faculty in the Department of Psychology that have experience with educational psychology and assessment. Statistical data will be collected and analyzed with the assistance of the University's Office of Institutional Research and faculty from the Department of Mathematics & Statistics who are not involved in proposing the intended reforms.

Several years ago, Youngstown State University formed the Public/Private Alliance, a consortium of colleges and universities located in Northeast Ohio and Western Pennsylvania. This consortium was established to forge links between the campuses in this region. A number

of articulation agreements have been signed to facilitate transfers between institutions. In addition, this consortium has been a very successful model for the development of multi-institutional chemical instrumentation facilities and has subsequently won substantial state financial support. A group of science faculty from these institutions will be asked to serve as a committee of outside reviewers to provide YSU with feedback on the project. Specific individuals have not yet been chosen, but Dr. John Andrews of Hiram College has agreed to act as the provisional chair. The principal investigators will also seek additional external reviewers from outside our local region with experience in science education and/or social science research to assess the revised general education program.

E. Dissemination of results

The principal investigators will publish reports on this new investigative laboratory program for non-science and technology majors in one or more science education journals. In addition, reports will also be published in the appropriate disciplinary teaching journals. Faculty in Biology and Chemistry have already developed new laboratory manuals for their majors. These will be adapted for the non-major courses and published. Software and descriptions of new laboratories will be published and will also be made available on the University's Web site. In particular, YSU faculty will work with science faculty from the Public/Private Alliance who are interested in implementing these reforms on their campuses.

The College of Arts & Sciences publishes a quarterly newsletter, *The Art & Science of Teaching* in which some of the principal investigators have already described previous reforms in their courses. The principal investigators will use this forum to share the outcomes of this project with the University community. There are plans to make this publication available on the University's World Wide Web site *(http://www.ysu.edu)* to enable it to be shared much more broadly.

Principal investigators will also make presentations at regional and national meetings devoted to science education and to regional and national meetings in their disciplines.

Since 1989, YSU has sponsored *Quest,* an annual showcase of student and faculty scholarly activity. A final means of dissemination will be for students, not necessarily science majors, to present results of research projects that were undertaken in their investigative laboratory courses at the annual *Quest* presentation.

II. References Cited

- 50 Hours: A Core Curriculum for College Students: Lynne V. Cheney, Chairman; National Endowment for the Humanities (1989), Wash. DC p. 43.
- B. Aarons, *A Guide to Introductory Physics Teaching*, John Wiley & Sons, New York, 1990.
- Cashman, J. R.; Berkman, C. E.; Underliner, G.; Speirs, R. J.; Kolly, C. A.; Hunter, A. D.: "Thiococaine: Synthesis, Analysis and Use in Assaying Cocaine Esterases," *Analytical Biochemistry*, 38 pages (**submitted for publication** July, 1997).
- E. Mazur, *Peer Instruction: A User's Manual*, Prentice Hall, Upper Saddle River, N. J. 1997.
- F. Reddish, "Implications of cognitive studies for teaching physics," *Am. J. Phys.* **62**, 796-803 (1994).
- F. Reif, "Understanding and teaching important scientific thought processes," *Am J. Phys.* **63**, 17-32 (1995).
- Hunter, A. D.: "A Capstone Writing Experience in Polymer Chemistry: Writing a Proposal to Management for the Purchase of New Polymer Characterization Instrumentation," *Journal of Chemical Education*, 8 pages (JCE # 1997-0196, **submitted for publication** March 14th, 1997; **revised version submitted** October 3rd, 1997). (1997a)
- Hunter, A. D.: "Crystallographic Structure Determination: An Experiment for Organic Analysis and other Non-Traditional Venues," *Journal of Chemical Education*, **in press**, 9 pages (accepted September 9th, 1997). (1997b)
- Hunter, A. D.: *X-Ray Structure Solution via SHELXTL: A Beginner's Guide*, Draft Version 009 © 1997, ≈160 pages. Used in Chemistry 832 for one year and submitted to about one dozen external reviewers for detailed comment to guide the January 1998 round of revisions and for use in their research and teaching. Submitted for publication to Siemens Industrial Automation, Madison WI. (1997c)
- Hunter, A. D.; Bianconi, L. J.; DiMuzio, S. J.; Braho, D. L.: "Synthesis and Structure/Property Relationships in (η^6-Arene)$Cr(CO)_3$ Chemistry: from Guided Experiments to Discovery Research. Physical Properties, IR, MS, and Multinuclear NMR Spectra, and Cyclic Voltammetry," *Journal of Chemical Education*, 52 pages (JCE #1997-0179, **in press** (accepted October 4th, 1997). (1997d)
- Hunter, A. D.; Burnett, M.; Lacarelli, V. G.; Tabellion, G. A.: "Steric Effects in (η^6-Arene)$Cr(CO)_3$ Complexes: Variable Temperature X-Ray and Neutron Diffraction Study of (η^6-1,2,3,5-$C_6H_2(OMe)_3(CO_2Me)$)$Cr(CO)_3$," manuscript in preparation for *Organometallics* (i.e. as a note) (expected submission date: November 20th, 1997). (1997e)
- Hunter, A. D.; Kwolek, K.; Leslie, K.: "Advanced Spectroscopic and Structural Methods: A Professional Development Course for High School Chemistry Teachers.

Why Shouldn't They Join the Fun?," manuscript in preparation for the *Journal of Chemical Education* (expected submission date: December 1st, 1997). (1997f)

- Hunter, A. D.; Pollack, J. E.; Zaworotko, M. J.; Christie, S.: "Boat Conformations in (η^6-Arene)$Cr(CO)_3$ Complexes: X-Ray Crystallographic Study of at 193 K for (η^6-1,4-$C_6H_4(NH_2)(NMe_2)$)$Cr(CO)_3$ (P1bar), at 293 K for (η^6-1,4-$C_6H_4(NH_2)(NMe_2)$)$Cr(CO)_3$ (P1bar and C2/c), and at 290 K for (η^6-1,4-$C_6H_4(NH_2)Cl$)$Cr(CO)_3$, and (η^6-C_6H_5Cl)$Cr(CO)_3$," 50 pages + ≈80 pages of supplementary material, manuscript in preparation for the *Journal of Organometallic Chemistry* (expected submission date: October 20th, 1997). (1997g)
- Hunter, A. D.; Pollack, J. E.; Zaworotko, M. J.; Furey, W. S.: "Donor/Acceptor Interactions in four (η^6-1,4-C_6H_4(Donor)(Acceptor))$Cr(CO)_3$ Complexes: X-Ray Crystallographic Study of (η^6-1,4-$C_6H_4(NH_2)(CO_2Me)$)$Cr(CO)_3$, (η^6-1,4-$C_6H_4(NMe_2)(CO_2Me)$)$Cr(CO)_3$, (η^6-1,4-$C_6H_4(OMe)(CO_2Me)$)$Cr(CO)_3$, and (η^6-1,4-$C_6H_4(NH_2)(CF_3)$)$Cr(CO)_3$," 49 pages + ≈100 pages of supplementary material, manuscript in preparation for the *Journal of Organometallic Chemistry* (expected submission date: October 22nd, 1997). (1997h)
- J. C. Dick, "Subsurface Investigations: A New Approach to Teaching Integrated Geological Principles," Geological Society of America, 1995 Annual Meeting, Program with Abstracts, New Orleans.
- L. C. McDermott, "What we teach and what is learned - closing the gap," *Am. J. Phys.* **59**, 301-315 (1991).
- Landis, K. G.; Hunter, A. D.; Wagner, T. R.; Curtin, L. S.; Filler, F. L.; Jansen-Varnum, S. A: "The Synthesis and Characterization of Ni, Pd, and Pt Maleonitriledithiolate Complexes: X-Ray Crystal Structures of the Isomorphous Ni, Pd, and Pt ($Ph_2PCH_2CH_2PPh_2$)M(Maleonitriledithiolate) Congeners," *Inorganica Chimica Acta*, 39 pages + 85 pages of supplementary material (**submitted for publication**, September 19th, 1997).
- M. Hazen and J. Trefil, *Science Matters: Achieving Scientific Literacy*, Doubleday, New York, 1991.
- P. Heller, and M. Hollabaugh, "Teaching problem solving through cooperative grouping. Part 2: Designing problems and structuring groups," *Am. J. Phys.* **60**, 637-644 (1992). (1992b)
- P. Heller, R. Keith, and S. Anderson, "Teaching problem solving through cooperative grouping. Part 1: Group versus individual problem solving," *Am. J. Phys.* **60**, 627-636 (1992). (1992a)
- Shaping the Future: New Expectations for Undergraduate Education in Science, Mathematics, Engineering and Technology; Executive Summary of its Review of Undergraduate Education by the Advisory Committee to the National Science Foundation (NSF 96-139, 1996), p. 2.

- The Liberal Art of Science: Agenda for Action (The Report of the Project on Liberal Education and the Sciences); American Association for the Advancement of Science (1990), Wash. DC p. vii.
- Tobias, *They're Not Dumb, They're Different*, Research Corporation Tucson, 1990.
- U. Treisman, "Studying students studying calculus: A look at the lives of minority mathematics students in college," Coll. Math. J. 23, 362-372 (1992).

Biographical Sketch for James H. Andrews

A. Vitae

Education

Ph.D. 1995 — Case Western Reserve University, *Cleveland, Ohio*
Dissertation: *Third Order Optical Nonlinearities in Organic Chromophores.*
(M.S. 1992) — NASA Graduate Researcher Fellowship
Advisor: Prof. Kenneth D. Singer, Associate Chairman, Dept. of Physics

B.S. 1989 — Cleveland State University, *Cleveland, Ohio*
summa cum laude, physics major, mathematics minor
Research Assistant to Prof. James A. Lock

J.D. 1982 — University of Virginia School of Law, *Charlottesville, Virginia*
Juris Doctorate

B.A. 1979 — Bucknell University, *Lewisburg, Pennsylvania*
magna cum laude, philosophy
Phi Beta Kappa, Jeffrey James Harold Prize in Electrical Engineering,

Summary of Experience

9/96-present — Youngstown State Unviersity
Physics & Astronomy Dept., One University Plaza, Youngstown, Ohio 44555-3616
Assistant Professor
Scientist-Educator for Project Discovery-Far East Region Professional Development Center
Director of YSU Center for Photon-Induced Processes

4/95--4/96 — NASA Lewis Research Center and Ohio Aerospace Institute (OAI)
21000 Brookpark Rd., Cleveland, Ohio 44135
Senior Research Associate in the Space Experiments Division.

Investigated laser feedback interferometry and constructed a laser feedback confocal microscope under a NASA Advanced Technology Directive for the study of fluid physics.

8/95-5/96 — Case Western Reserve University (CWRU)
10900 Euclid Ave., Cleveland, Ohio 44106-7079
Lecturer in Physics

Helped implement active learning strategies by using cooperative groups, context-rich problems, and computer-assisted virtual laboratories in the honors introductory physics sequence and in courses for engineering and life science majors.

1989-5/95 — NASA Lewis Research Center and Case Western Reserve University
Research Assistant and NASA Graduate Research Fellow (from July, 1992).

Thesis Advisor (CWRU): Prof. Kenneth D. Singer, Associate Chairman
Technical Advisor (NASA): Dr. Kathy C. Chuang, Conducting Polymers

Research in numerous aspects of nonlinear and applied optics, developed experimental techniques and tools for characterizing molecular organic nonlinear optical materials and waveguide devices, built a tunable pulsed subpicosecond light source, and developed a theory of cascaded optical nonlinearities with local field effects.

1982-1988 Squire, Sanders & Dempsey
4900 Society Center, Cleveland, Ohio 44114-1304
Attorney-Public Finance and Corporate Departments

Professional Affiliations: American Physical Society-Division of Atomic, Molecular, and Optical Physics, Optical Society of America, American Association of Physics Teachers,

B. Five Most Relevant Publications:

(1) J. H. Andrews, "Active Learning in Introductory Physics," *The Art and Science of Teaching*, 2, 3 (Youngstown State University, Spring, 1997).

(2) J. A. Lock and J. H. Andrews, "Optical Caustics in Natural Phenomena," *Am. J. Phys.* **60**, 397-407 (1992).

(3) J. H. Andrews, J. D. V. Khaydarov, K. D. Singer, D. L. Hull, and K. C. Chuang, "Characterization of Excited States of Centrosymmetric and Noncentrosymmetric Squaraines by Third Harmonic Spectral Dispersion," *J. Opt. Soc. Am. B.* **12**, 2360-2371 (1995).

(4) J. D. V. Khaydarov, J. H. Andrews and K. D. Singer, "Pulse Compression Mechanism in a Synchronously Pumped Optical Parametric Oscillator," *J. Opt. Soc. Am. B* **12**, 2199-2208 (1995).

(5) J. Andrews, K. Andre, P. Cramer, and M. Singham, "Active Learning: What does it actually look like? Cooperative Groups and Context-Rich Problems," talk presented at the Spring 1995 Meeting of The Ohio Section of the American Physical Society (May 13, 1995) (Youngstown, Ohio).

Five Other Significant Publications:

(6) K. D. Singer and J. H. Andrews, "Contribution of Two-Photon States to Third Order Optical Nonlinearities," invited overview for *Condensed Matter News* **3**, 7-13 (1994).

(7) J. H. Andrews, J. D. V. Khaydarov, and K. D. Singer, "Contribution of the 2^1Ag State to the Third Order Optical Nonlinearity in a Squaraine Dye," *Opt. Lett.* **19**, 984-986 (1994); *errata, Opt. Lett.* **19**, 1909 (1994).

(8) K. D. Singer and J. H. Andrews, "Quadratic Nonlinear Optics in Poled Polymer Films: From Physics to Devices," invited book chapter in *Molecular Nonlinear Optics: Materials, Physics and Devices*, J. Zyss, ed. (Academic Press, New York, 1994) 295-298.

(9) J. H. Andrews and K. D. Singer, "Photoinduced Diffraction in Polymer Waveguides," *Appl. Opt.* **32**, 6703-6709 (1993).

(10) J. H. Andrews, K. L. Kowalski, and K. D. Singer, "Pair Correlations, Cascading, and Local-field Effects in Nonlinear Optical Susceptibilities," *Phys. Rev. A* **46**, 4172-4184 (1992).

C. OTHER COLLABORATORS: Steven Eppell, Case Western Reserve University, Ben Ovryn, NASA Lewis Research Center, Paul Cahill, Sandia National Laboratories.

D. GRADUATE ADVISEES: None

E. ADVISOR: Dr. Kenneth D. Singer (Graduate Advisor), Dr. Kathy Chuang (NASA Technical Advisor)

WILLIAM R. BUCKLER, Ph.D.
ASSISTANT PROFESSOR
DEPARTMENT OF GEOGRAPHY
YOUNGSTOWN STATE UNIVERSITY, 1 UNIVERSITY PLAZA, YOUNGSTOWN, OH 44555
PHONE: (330) 742-1801 FAX: (330) 742-1802 E-MAIL: wbuckler@cc.ysu.edu

---

EDUCATION

Ph.D., Geography, Michigan State University, East Lansing, Michigan, 1981, Dissertation Title: "Rates and Implications of Bluff Recession Along the Lake Michigan Shorezone of Michigan and Wisconsin", Advisor: Dr. Harold A. Winters. ◆ *M.A.*, Geography, Michigan State University, East Lansing, Michigan, 1973, Research Papers: "Bluff Erosion at Selected Sites Along the Southeastern Shore of Lake Michigan" and "Variation in Water Level and Precipitation in the Lake Michigan Basin", Advisors: Dr. Harold A. Winters and Dr. Jay Harman. ◆ B.A., Geography, Wayne State University, Detroit, Michigan, 1969.

PROFESSIONAL EXPERIENCE

1989 to Present - Assistant Professor of Geography, Youngstown State University, Youngstown, Ohio ◆ 1983 to 1989 - Assistant Professor of Geography, East Carolina University, Greenville, North Carolina ◆ 1981 to 1983 - Assistant Professor of Geography, Bowling Green State University, Bowling Green, Ohio ◆ 1980 to 1981 - Instructor of Geography, Michigan State University, East Lansing, Michigan ◆ 1979 to 1980 - Contract Manager and Research Assistant, Center for Remote Sensing, Michigan State University, East Lansing, Michigan ◆ 1977 to 1979 - Principal Contract Investigator and Research Assistant, Remote Sensing Project, Michigan State University, East Lansing, Michigan ◆ 1976 to 1977 and 1971 to 1975 - Graduate Teaching Assistant in Geography, Michigan State University, East Lansing, Michigan ◆ 1975 to 1976 -Instructor of Geography, Central Michigan University, Mt. Pleasant, Michigan ◆ 1975 - Instructor of Geography, Wayne State University, Detroit, Michigan ◆ 1974 - Geographic Analyst, Central Intelligence Agency, Washington, D.C. ◆ 1972 - Aerial Photo Interpreter, Project for the Use of Remote Sensing in Land and Resource Use Policy, Michigan State University, East Lansing, Michigan ◆ 1971 - Cartographer Specialist, Department of Geography, Wayne State University, Detroit, Michigan ◆ 1970 - Instructional Assistant in Geography, Wayne State University, Detroit, Michigan ◆ 1968 to 1969 - Substitute Teacher, Detroit Public School System, Detroit, Michigan

PERTINENT EXPERIENCE RELATED TO GRANT APPLICATION

I am the local implementer of a $5 million national K-12 teacher enhancement project funded by a NSF grant (No. ESI-9453205) and awarded to the American Meteorological Society (PI: Dr. Ira W. Geer). Over a five year period under this grant, *The DataStreme Project: Teacher Enhancement through the Use of Current Environmental Data Across the Curriculum*, 4,100 K-12 teachers will be trained, in an intensive course offered at local sites twice a year, to become weather education resource teachers for their schools. The course emphasizes the teaching of integrated science through problem-focused or event driven investigations of an atmospheric science nature and incorporates weather data, summaries and learning material delivered in real-time over the Internet. The AMS has submitted a NSF proposal asking for funds to develop a similar type of course directed toward undergraduate college students. If funded, I would be one of the test instructor to implement such a course in a local setting. Experience gained in being involved with these AMS programs will be incorporated into developing the proposed YSU laboratory-oriented weather course. The AMS also sponsored a two-week intensive workshop ("Advances in Meteorological Sensing, Analyzing, and Forecasting") for me at the National Weather Service Training Center in Kansas City in the summer of 1994; this was funded through the NSF grant cited above.

AFFILIATIONS

Association of American Geographers
American Meteorological Society

PUBLICATIONS

Buckler, W.R. 1988. "General Land Office Resurveys: A Methodology for Determining Long-Term Shoreland Recession Rates." *Papers and Proceedings of the 11th Annual Applied Geography Conference* 11:17-26.

Buckler, W.R., H.A. Winters & J.P. LaMoe. 1988. "Bluff Crest Recession Along the Southwest Shore of Southern Michigan." Wisconsinan and Holocene Stratigraphy in Southwestern Michigan. *Midwest Friends of the Pleistocene 35th Field Conference Proceedings*, pp. 51-60.

Buckler, W.R. 1988. "Computer Generated 3-D Maps: Models for Learning Contour Map Reading." *The Journal of Geography* 87(2):49-58.

Buckler, W.R. 1987. "High Water Levels and Bluff Recession: Lake Michigan's Southeast Shore." *The East Lakes Geographer* 22:157-177.

Buckler, W.R. 1986. "Establishing Geomorphic Criteria for Michigan's Sand Dune Protection and Management Act." *Papers and Proceedings of Applied Geography Conference* 9:73-84.

Buckler, W.R. and T. Hidlebaugh. 1983. "Thickness and Depletion of the Organic Soils in the Celeryville-Willard Marsh of North-Central Ohio." *The East Lakes Geographer* 18:38-53.

Buckler, W.R. and H.A. Winters. 1983. "Lake Michigan Bluff Recession." *Annals of the Association of American Geographers* 73(1):89-110.

Buckler, W.R. 1983. "Rates and Implications of Bluff Recession Along the Lake Michigan Shorezone of Michigan and Wisconsin." *Proceedings, Third Workshop on Great Lakes Coastal Erosion and Sedimentation*, pp. 13-16. National Research Council, Ottawa, Canada. (Invited Paper)

Buckler, W.R. 1980. *Bluff Recession Rate Study: .....Township, ...County, Michigan* (21 reports contracted by the Michigan State University Center for Remote Sensing with the Michigan Department of Natural Resource, 8-30 pp. each)

Buckler, W.R. 1979. "Dune Type Inventory and Barrier Dune Classification Study of Michigan's Lake Michigan Shore." *Report of Investigation No. 23.* Geological Survey Division, Michigan Department of Natural Resources, Lansing, MI, 36 pp.

SELECTED PROFESSIONAL DEVELOPMENT

Workshops on The DataStreme Project, a National Science Foundation-funded, American Meteorological Society-sponsored and National Weather Service-supported K-12 teacher-enhancement program of which I am the local leader and instructor, January 2-5 and

"Advances in Meteorological Sensing, Analyzing, and Forecasting," NSF-funded, American Meteorological Society/National Weather Service-sponsored Faculty Enhancement Workshop at the NWS Training Center, Kansas City, Missouri, July 25-August 5, 1994

"Descriptive Soils for the Archaeologist and the Environmental Scientist," National Science Foundation Chautauqua Short Course for College Teachers, Northeast Louisiana University/Poverty Point State Commemorative Area, Monroe, Louisiana, February 25-27

"The Greenhouse Effect and Global Climatic Change," National Science Foundation Chautauqua Short Course for College Teachers, Oregon Graduate Institute of Science and Technology, Portland, Oregon, March 25-26

THESIS ADVISEMENT

Theresa Hidlebaugh. 1982. *Thickness and Depletion of the Organic Soils in the Celeryville-Willard Marsh of North-Central Ohio.* M.A.Thesis, Department of Geography, Bowling Green State University.

Biographical Sketch for Allen D. Hunter.

Department of Chemistry, Youngstown State University, Youngstown, OH, 44555.

A. Vitae. Allen Hunter received his Honors B.Sc. in Chemistry in 1981 from the University of British Columbia in Canada with a graduating thesis under Dr. E.E. Burnell entitled "A NMR Structural Determination of Azulene Oriented in a Nematic Liquid Crystal". Allen obtained his Ph.D. degree from the University of British Columbia in 1985 under Dr. P. Legzdins with a thesis entitled "Aspects of the Organometallic Nitrosyl Chemistry of Cr, Mo, and W". He worked as a postdoctoral fellow with Dr. M. Bennett of the Research School of Chemistry at the Australian National University in Canberra, Australia, doing phosphine and iron phosphine chemistry (1985-86) and with Dr. M. Cowie at the University of Alberta in Canada carrying out single crystal X-ray diffraction studies for Dr. D. Seyferth of M.I.T. (1987). From 1987 to 1992 Allen was an Assistant Professor of Chemistry at the Chemistry Department of the University of Alberta where he currently holds an Adjunct appointment. On September 15th of 1992 he joined Youngstown State University as an Associate Professor of Chemistry. He is a member of the American Chemical Society, the American Association for the Advancement of Science, The American Crystallographic Association, The Council of Undergraduate Research and three other professional associations. Dr. Hunter has extensive experience in the use of mass spectrometry, nuclear magnetic resonance spectrometry and X-ray crystallography in inorganic and organometallic chemistry. He is experienced with small PC networks including mixtures of Apple and IBM systems. He has extensive experience with Varian NMR spectrometers and experience with Siemens and Enraf Nonius X-ray diffractometers. He is one of two designated faculty coordinators of YSU's new Gemini-2000 400 MHz NMR and of our Siemens X-ray diffractometers. He is also the director of the YSU Structure Center and serves as the representative for YSU and other predominantly undergraduate institutions in Ohio on State wide coordinating committees for NMR and X-ray consortia.

Allen received a Izaak Walton Killam Memorial Postdoctoral Fellowship and a NSERC Postdoctoral Fellowship for 1985-87 and he held a Natural Sciences and Engineering Research Council of Canada, NSERC, Graduate Scholarship for 1981-85. He received the Governor General's Gold Medal in Arts and Sciences, the Lefevre Medal and Prize in Honors Chemistry, and the Society of Chemical Industry Merit Award in 1981. Allen held a NSERC Undergraduate Summer Research Award in 1980 and 1981. He was awarded the Chemical Institute of Canada Prize in 1980 and Charles A. and Jane C.A. Banks Foundation Scholarships for 1978-80.

During the 1990-93 period Allen received over $400,000 (US), excluding overhead, in external funding at the University of Alberta from the Canadian federal science granting agency, NSERC, and US and Canadian Industry for his work on organometallic polymers and biologically active organometallics. Since coming to YSU he has been PI or co-PI on instrumentation grants totaling over $500,000 which have supported the YSU Chemistry Department's innovative teaching program.

B. Refereed Journal Publications, Allen has had 36 refereed journal publications, generally in American Chemical Society Journals, including 17 since 1992. A selection of five

additional publications that have recently been submitted and which are related to this proposal is presented below.

- Hunter, A. D.: "A Capstone Writing Experience in Polymer Chemistry: Writing a Proposal to Management for the Purchase of New Polymer Characterization Instrumentation," *Journal of Chemical Education*, 8 pages (**revised version submitted** October 3rd, 1997).
- Hunter, A. D.: "Crystallographic Structure Determination: An Experiment for Organic Analysis and other Non-Traditional Venues," *Journal of Chemical Education*, **in press**, 9 pages (accepted September 9th, 1997).
- Hunter, A. D.: *X-Ray Structure Solution via SHELXTL: A Beginner's Guide*, Draft Version 009 © 1997, ≈160 pages. Used in Chemistry 832 for one year and submitted to about one dozen external reviewers for detailed comment to guide the January 1998 round of revisions and for use in their research and teaching. Submitted for publication to Siemens Industrial Automation, Madison WI.
- Hunter, A. D.; Bianconi, L. J.; DiMuzio, S. J.; Braho, D. L.: "Synthesis and Structure/Property Relationships in (η^6-Arene)$Cr(CO)_3$ Chemistry: from Guided Experiments to Discovery Research. Physical Properties, IR, MS, and Multinuclear NMR Spectra, and Cyclic Voltammetry," *Journal of Chemical Education*, 52 pages **in press** (accepted October 4th, 1997).
- Cashman, J. R.; Berkman, C. E.; Underliner, G.; Speirs, R. J.; Kolly, C. A.; Hunter, A. D.: "Thiococaine: Synthesis, Analysis and Use in Assaying Cocaine Esterases," *Analytical Biochemistry*, 38 pages (**submitted for publication** July, 1997).

C. **Other Collaborators:** None.

D. **Graduate Students**: X. Andrew Guo, Ph.D. 1994 (University of Alberta), Xiaochung Wang, MS 1994 (Youngstown State University), Larry J. Bianconi, MS 1994 (Youngstown State University), Stanislaus Tsai, Ph.D. 1995 (University of Alberta), Dianne Braho, MS 1995 (Youngstown State University), Steven DiMuzio, MS 1996 (Youngstown State University), and Bev Smith-Papa, MS 1997 (Youngstown State University).

E. **Advisors:** Detailed in Section A, above.

ALAN M. JACOBS, Ph.D., P.G.
DIRECTOR
CENTER FOR ENVIRONMENTAL STUDIES
YOUNGSTOWN STATE UNIVERSITY, 1 UNIVERSITY PLAZA, YOUNGSTOWN, OH 44555

EDUCATION

Ph.D., Geology, Indiana University, Bloomington, Indiana, 1967; Minors: Ecology and Pleistocene Pollen Analysis; Dissertation Title: "Pleistocene Proto-Cirque Hollows in the Tobacco Root Mountains (Jefferson County), Montana."; *M.A.*, Geology, Indiana University, Bloomington, Indiana, 1965; *B.S. (Honors)*, Geology, The City College, City University of New York, 1963; Honors Research: "Differential Thermal Analysis of Clay Minerals." Graduate Advisors: Dr. William D. Thornbury (Indiana, deceased); Dr. David G. Frey (Indiana, deceased); Dr. Herbert E. Wright (Minnesota, retired).

REGISTRATIONS/CERTIFICATIONS

AIPG: Certified Professional Geologist, CPG No. 2675, AIPG, 1974+; *Delaware:* Professional Geologist, No. 209, 1974+; *California:* Registered Geologist, No. 3452, 1978+; Cert. Engineering Geologist, No. 1053, 1979+; *Pennsylvania:* Professional Geologist, No. PG-000674-G, 1994+.

PROFESSIONAL/ RESEARCH EXPERIENCE

1996 to Present - Director: Center for Environmental Studies and Associate Professor of Geology, Youngstown State University, Youngstown, Ohio ** 1979 to 1996 - President: Alan M. Jacobs, Inc./ GEOPROBE, Pittsburgh, Pennsylvania (*Developed specialized techniques and hardware for underground and underwater television probes used in boreholes, monitoring wells, and mines)* ** 1993 to 1995 - Director of Environmental Assessment: Paul C. Rizzo Associates, Monroeville, Pennsylvania ** 1987 to Present - Part-time Instructor: Carnegie-Mellon University (*Department of Civil and Environmental Engineering)*, Pittsburgh, Pennsylvania ** 1988 to 1993 - Senior Technical Associate and Project Manager: IT Corporation, Monroeville, Pennsylvania (*Developed a cooperative program with West Virginia University to offer graduate level courses in environmental sciences at the office after hours)* ** 1974 to 1981 - Senior Project Geologist: D'Appolonia Consulting Engineers, Pittsburgh, Pennsylvania ** 1967 to 1974 - Research Geologist: Illinois Geologic Survey, Urbana/Champaign, Illinois ** 1963 to 1967 - Teaching and Graduate Studies: Indiana University, Bloomington, Indiana, and the Geologic Field Station, Cardwell, Montana (*Taught general geology laboratories, geomorphology laboratories, glacial geology laboratories, and field geology)* ** Summer 1965 - Geologist, Indiana Geological Survey, Bloomington, Indiana ** Winter/Spring 1965- Traveling Scholar: University of Minnesota, Minneapolis, Minnesota; laboratory studies in pollen analysis ** Summers of 1964, 1965, & 1966- Dissertation Research: Tobacco Root Mountains, Jefferson County, Montana.

GRANT MANAGEMENT AND GRANT-SUPPORTED RESEARCH

Ohio Environmental Education Fund (Principal) (No. 97G-062) May 1, 1997 - October 31, 1997- "Environmental Education for Adult Audiences Using Theatrical Presentation" Total Award: $46, 174; Remaining: $46,174; National Science Foundation (Principal Investigator) (No. DUE 9552347) NSF-ILI "Instrument and Laboratory Improvement -- Environmental Studies Program"; Total Award: $25,000; YSU Matching: 46,000; YSU

PACER- (Co-Investigator) July 1, 1997 - June 31, 2000- "Mahoning River Basin Research Center"-- Areas of Research: Brownfields and Geographic Information Systems. Total Award (for all investigators): $84,500.

AFFILIATIONS

American Institute of Professional Geologists; Pennsylvania Section, Secretary/Treasurer: 1981 and 1982; President, 1983 and 1984, Executive Committee: 1985 and 1986 Explorers Club, New York, Fellow; Geological Society of America; Pittsburgh Geological Society; Phi Beta Delta, International Scholars Honorary Society.

PUBLICATIONS

1. Jacobs, A. M., A. G. Harris, and I. U. Khawaja, 1997, "Using Topographic Indicators to Prevent Environmental Damage from Mine Subsidence," 4th International Conference on Geomorphology, University of Bologna, Italy, Aug./Sept. 1997.
2. Jacobs, A., 1987, "Tracing Contaminant Leaks Using Borehole TV," *Proceedings, Second International Conference on New Frontiers for Hazardous Waste Management*, EPA/600/9-87/018F, pp. 561-571.
3. Lineback, J.A. (compiler), P.B. DuMontelle, L.R. Follmer, D.L. Gross, A.M. Jacobs, J.P Kempton, J.A. Lineback, E.D. McKay, and P.C. Reed, 1979, "Quaternary Deposits of Illinois," map, 1:500,000, Illinois State Geological Survey, Urbana, Illinois.
4. Jacobs, A.M., 1971, "Geology for Planning in St. Clair County, Illinois," *Circular 465*, Illinois State Geological Survey, Urbana, Illinois.
5. Jacobs, A.M., 1971, "Statistical Considerations for Grain-Size Analyses in Tills," *Mathematical Geology*, Vol. 3, No. 3, pp. 227-238.

THESIS ADVISEMENT

Student: Anastasios Tachiaos, Carnegie-Mellon University, Department of Civil Engineering, Master's Thesis: "Enhanced Expert System for Geotechnical Site Characterization." Direct supervision on geologic and geomorphologic matters in association with Professor (now Provost) Paul Christiano. Supported under NSF Grant No. MSM 85-12807.

Curriculum Vita: Heather E. Lorimer:

Assistant Professor, Genetics, Dept. of Biological Sciences, Youngstown State University

Education

The University of Chicago, Chicago, Illinois
A. B. (Biology), 1982

Columbia University, Graduate School of Arts and Sciences
Dept. of Biological Sciences, New York, NY, advisor Dr. C. Prives
M. A., 1988
M. Phil., 1989
Ph.D., October, 1992

Courses Taught:

Principles I - molecular and cellular biology for biology majors.
Biology and the Modern World - Biology for non-majors
Principles of Biology II lab - organismal biology for biology majors
Genetics - classical and advanced genetics for biology majors
Virology - molecular virology for graduate students in biology

Professional Associations, Committees and Projects:

Association for Women in Science, member 1996-1997

Collaborative Learning Discussion Group, member 1996-1997

Women's in the Sciences group of the Women's Studies Committee, 1997.

Revision of biology for non-majors "Biology and the Modern World", as a member of an *ad hoc* committee within the Department of Biological Sciences. - We defined new course goals and objectives, screened dozens of potential new textbooks, and selected one "Basic Concepts in Biology" by Cecie Starr, 3rd edition, 1997, Wadsworth Publishing Company. This textbook covers broad areas of Biology clearly and coherently. It contains a wealth of relevant and interesting information, and will be a great boon to the course. In addition, this text comes with a wide variety of support materials including CD-ROM computer modules, web-page and other internet links, a videodisc with animations and films, and STELLA II, a software tool with 23 simulations aimed at developing critical thinking skills.

Chair: *ad hoc* committee on departmental web-page development

Chair: Committee for development of capstone course/requirements for Biology majors

Appointments/ Awards

University Research Council grant #999, (intramural, Youngstown State U.)
"Mechanisms of Wild-Type and Mutant Mitochondrial DNA Replication in the Yeast *Saccharomyces Cerevisiae*" funded for 1997-1998

Human Frontiers in Science Project Long Term Fellowship, starting Oct. 1, 1997,
collaborator: Ian Holt, University of Dundee, Dundee, Scotland
(declined upon acceptance of position at Youngstown State University)

American Cancer Society Postdoctoral Research Fellow Jan. 1, 1994 through Dec. 31, 1996 with Dr. W. Fangman and Dr. B. Brewer, Dept. of Genetics, University of Washington - *mitochondrial DNA replication and segregation in yeast*

Research Publications:

Bhattacharyya, S., **H. E. Lorimer,** and C. Prives. 1995. Murine polyomavirus and simian virus 40 large T antigens produce different structural alterations in viral origin DNA. J. Virology 69(12):7579-7585

Lorimer, H. E., B. Brewer, and W. L. Fangman. 1995. A test of the transcription model for the biased inheritance of yeast mitochondrial DNA. Mol. Cell. Biol. 15 (9):4803-4809.

Lockshon, D., S. G. Zweifel, L. L. Freeman, **H. E. Lorimer,** B. J. Brewer, and W. L. Fangman. 1995. A role for recombination junctions in the segregation of mitochondrial DNA in yeast. Cell 81:947-955.

Lorimer, H. E., I. Reynisdottir, S. Ness, and C. Prives. 1993. Unusual Properties of a replication-defective mutant SV40 large T antigen. Virology 192:402-414.

Lorimer, H. E., E. H. Wang, and C. Prives. 1991. DNA binding properties of polyoma large T antigen are altered by ATP and other nucleotides. J. Virol. 65:687-699.

Science education related publications:

Genetics editor of "The Cat Fanciers Journal" published by Kerrie Meek in association with the American Association of Feline Practitioners, since 1992

Meetings Attended:

Speaker:

European Union Mitochondrial Group: Aussois, France, 1996 *MGT1*, recombination structures, and inheritance of mitochondrial DNA in the yeast *Saccharomyces cerevisiae*: H. E. Lorimer, B. Brewer, and W. Fangman

Other Presentations:

Eukaryotic DNA Replication: Cold Spring Harbor, NY. 1997 "Mechanisms of Human Mitochondrial DNA Replication" I. J. Holt, H. E. Lorimer, H. T. Jacobs

Gordon Research Conference: Extrachromosomal Elements, Volterra, Italy, 1994 "*MGT1*, recombination structures, and inheritance of mitochondrial DNA in the yeast *Saccharomyces cerevisiae*. H. E. Lorimer, B. Brewer, and W. Fangman.

Papovaviruses and Adenoviruses, Cambridge, England, 1991 "Polyoma and SV40 T Antigens Melt Different Regions Within the Polyoma Replication Origin" H. E. Lorimer and C. Prives

SV40, Polyoma, and Adenoviruses, Cold Spring Harbor Laboratory, NY, 1990 "The C11A Mutant of SV40 T Antigen is Temperature Sensitive for ATPase and ATP Dependent DNA binding." H. E. Lorimer, S. Ness, and C. Prives

Eukaryotic DNA replication, Cold Spring Harbor Laboratory, NY, 1989 "ATP dependent stimulation of replication-related functions of Polyomavirus large T antigen." H. E. Lorimer, E. Wang, and C. Prives

DNA Tumor Viruses, Cold Spring Harbor Laboratory, NY, 1988 "Polyomavirus large T antigen binding of viral origin DNA is enhanced by ATP". H. E. Lorimer and C. Prives

Biographical Sketch for Sherri Lovelace-Cameron

Department of Chemistry, Youngstown State University, Youngstown, Ohio 44555

A. Vitae. Sherri R. Lovelace-Cameron earned a BS in Chemistry form Drexel University in 1986. She then enrolled in the chemistry graduate program at the University of Pittsburgh. Under the direction of Dr. N. John Cooper, she completed her Ph. D. thesis in Inorganic Chemistry in 1992. Her thesis title was " Electrochemical Studies of Reduced Manganese Complexes with Arene, Cyclopentadienyl and Indenyl Ligands". In the fall of 1992 Dr. Lovelace joined Professor William E. Geiger's' group in the Department of Chemistry at the University of Vermont as a postdoctoral research assistant. In the fall of 1995, Sherri began her current position as Assistant Professor in the Department of Chemistry at Youngstown State University.

Sherri received a Citibank Postdoctoral Fellowship for (1993 -94). During her graduate studies she received a NAACP Sutton Education Scholarship (1991-92) and a Department of Education Fellowship (1989-90). As an undergraduate she was awarded a Gulf Oil Scholarship (1981-85).

Dr. Lovelace is a member of the American Chemical Society, the Association of Women in Science, the Council on Undergraduate Research, the National Organization for the Professional Advancement of Black Chemist and Chemical Engineers, and the Society of Electroanalytical Chemistry.

B. Refereed Journal Publications.

"Linear Oligo (ferrocenyldimethylsilanes) with between Two and Nine Ferrocene Units: Electrochemical and Structural Models for Poly (ferrocenylsilane) High Polymers." Rulkens, Ron; Lough, Alan J.; Manners, Ian; Lovelace, Sherri R.; Grant, Casey; Geiger, William E. *J. Am. Chem. Soc.* **1996**, 118, 12683.

"Synthesis and Properties of the 17-Electron, Tantalum-Centered Radical $Ta(CO)_4(Ph_2PCH_2CH_2PPh_2)$." Koeslag, M. A.; Baird, M. C.; Lovelace, S. R.; Geiger, W. E., *Organometallics* **1996**, 15, 3289.

"Reductively Induced Dimerization of the Ligated Benzene in $[Mn(h^6\text{-}C_6H_6)(CO)_3]^+$: Formation of the Initial C-C Bond by Anion/Cation Addition." Lee, S.; Lovelace, S. R.; Arford, D. J.; Geib, S. J.; Weber, S. G.; Cooper, N. J. *J. Am. Chem. Soc.* **1996**, 118, 4190.

"Two-Electron and One-Electron Reduction of the Indenyl Complex $[Mn(h^5\text{-}C_9H_7)(CO)_3]$ and Reversible Counterion-Controlled Comproportionation of $[Mn(h^5\text{-}C_9H_7)(CO)_3]$ and $[Mn(h^3\text{-}C_9H_7)(CO)_3]^{2-}$ To Give $[Mn(h^5\text{-}C_9H_7)(CO)_3]^{\cdot}$." Lee, S.; Lovelace, S. R.; Cooper, N. J. *Organometallics* **1995**, 14, 1974.

"Infrared Spectroelectrochemistry of Boron-Hydrogen Stretches: A Tool for Diagnosis of Delocalization in Mixed-Valent Metallacarborane Complexes." Teen T. Chin, Sherri R. Lovelace, William E. Geiger, Craig M. Davis, Russell N. Grimes, *J. Am. Chem. Soc.* **1994**, 116, 9359.

C. List of Other Collaborators.

(1) Dr. Folami Ladipo - University of Kentucky, Lexington Project-"Developing a Sustainable Graduate Study Recruitment Program via Research Opportunities in Chemistry".

D. Names of Mentors.

(1) Ph.D. Advisor. Dr. N. John Cooper, Department of Chemistry, University of Pittsburgh, Pittsburgh, PA 15260.

(2) Postdoctoral Advisor. Dr. William E. Geiger, Department of Chemistry, University of Vermont, Burlington, VT 05405.

BIOGRAPHICAL SKETCH

R. Bruce Mattingly

EDUCATION

- Ph.D., Applied Mathematics, North Carolina State University, 1988.
- M. Eng., Applied Mathematics, University of Louisville, 1982.
- B. S., Applied Science, University of Louisville, 1980.

ACADEMIC AND PROFESSIONAL EXPERIENCE

- Youngstown State University, 1995-present, Assistant to the Dean, College of Arts & Sciences.
- Youngstown State University, 1993-present, Associate Professor, Mathematics.
- Youngstown State University, 1988-1993, Assistant Professor, Mathematical and Computer Sciences.
- North Carolina State University, 1982-1988, Graduate Teaching and Research Assistant, Mathematics.
- University of Louisville, 1981-1982, Graduate Teaching Assistant, Applied Mathematics and Computer Science.

PUBLICATIONS RELATED TO TEACHING

- Editor, *The Art & Science of Teaching*, a quarterly newsletter published by the College of Arts & Sciences, Youngstown State University, 1995-present.
- Invited participant, *1997 ATLAST Developers Workshop,* on software tools for teaching linear algebra, June 1997, La Jolla, CA. Will be listed as a contributor to the second edition of *ATLAST. Computer Exercises for Linear Algebra,* edited by S. Leon, E. Herman, and R. Faulkenberry.

SIGNIFICANT PUBLICATIONS

1. *Orthogonal reduction on vector computers* (with C. D. Meyer and J. M. Ortega), SIAM J. Sci. Stat. Comp., Vol. 10, No. 2, March 1989, pp. 372-381.

2. *Computing the stationary distribution vector of an irreducible Markov chain on a shared-memory multiprocessor* (with C. D. Meyer), Numerical Solution of Markov Chains, Marcel Dekker, Inc., 1991, pp. 491-510.

3. *Implementing an O(sqrt{N} M) cardinality matching algorithm* (with N. P. Ritchey), Network Flows and Matching: First DIMACS Implementation Challenge, D. S. Johnson and C. C. McGeoch, editors, DIMACS Series in Discrete Mathematics and Theoretical Computer Science, Volume 12, American Mathematical Society, 1993, pp. 539-556.

4. *Solving Markov chains using bounded aggregation on a massively parallel processor*, Proceedings of the Fifth IEEE Symposium on Parallel and Distributed Processing, IEEE Computer Society Press, 1993, pp. 128-133.

5. *A revised stochastic complementation algorithm for nearly completely decomposable Markov chains*, ORSA Journal on Computing 7 (1995), pp.117-124.

LIST OF COLLABORATORS

None, other than those listed in publication list.

GRADUATE ADVISORS

Khaled A. Kamel, University of Louisville

Carl D. Meyer, Jr., North Carolina State University

STUDENT RESEARCH PROJECTS DIRECTED

1. Goodlin, Don. Matrix Theory. Graduate Independent Study (Mathematics 990), Fall 1992.

2. White, Lisa. Sparse Matrix Software, Undergraduate Project (Mathematics 896), Winter 1994.

3. Knickerbocker, Douglas. Mathematical Methods for Ranking College Football Teams, Undergraduate Project (Mathematics 896), Spring 1994.

4. Theophanous, Georgia. A Study of the Generalized Minimal Residual Algorithm, Graduate Project (Mathematics 996), Spring 1994.

SERVICE ON MASTER'S THESIS COMMITTEES

1. Labbiento, Julianne. Solving the Matrix Balancing Problem, directed by Nathan P. Ritchey, Winter 1994.

Charles R. Singler
Professor of Geology, Department of Geology
Assistant to the Dean, Arts & Sciences
Youngstown State University
Youngstown, OH 44555
(330) 742-3611
(330) 742-3408

Academic Experience:

(1969-present) Youngstown State University, Assistant Professor, Associate Professor, Professor (1980); Chair, Department of Geology, (1982-1987); Department Coordinator, Spring 1997; Assistant to the Dean, Arts & Sciences (1993-present)
(1978-79) University of Utah, Visiting Associate Professor
(1968-69) University of Nebraska, Lincoln, Instructor
(1967-68) John F. Kennedy College, Instructor

Education:

Ph.D., University of Nebraska, Lincoln, 1969, Geology
M.S., University of Nebraska, Lincoln, 1965, Geology
B.S., City College of New York, 1963, Geology
- University of Utah, 1978-79, Sabbatical
- University of San Diego, 1993, NSF Short Course, "Marine Science"
- University of Dayton, 1987, NSF Chatauqua Short Course, "Evolution, Creationism or Both?"
- Hofstra University, 1973, NSF Short Course "Microscopy"
- University of Nevada, Reno, 1969, NSF Short Course, "Field Geology of Basin and Range Province, Nevada"

Professional Activities/ Services:

1. Research grant (w/I. Khawaja & E. Abram) (1988-89) from Ohio Air Quality Development Authority, for radon studies
2. Research grant (w/I. Khawaja & E. Abram) (1992-93) from Ohio Department of Health and Mahoning County Health Department, for radon studies
3. MURC Radon Proficiency Program (exam 5/94 and 8/97) EPA Radon Measurement Proficiency (RMP) Program; Listing 8/94-9/99, (#164080T)

Scholarship:

I. Radon

a) Singler, C.R., 1993, Measuring Outcomes in Determining Public Health Risks - Radon Studies in Eastern Ohio: Presentation to the 74th Conference of Ohio Health Commissioners, October 20, 1993.

b) Singler, C.R., et al., 1993, A Predictive Model for Determining Indoor Radon Levels in Northeastern Ohio: 1993 International Radon Conference (AARST), Sept. 20-23, 1993, Denver, CO (Abstr.) p. IVP 12-13.

c) _____, 1991, Radon in Eastern Ohio - The Geologic Connection: Geological Society of America, North-Central Meeting, April 18-19, 1991, Toledo, OH (abstr.), p. 60.

d) _____, 1990, Indoor Radon in Eastern Ohio: The Role of Rock and Soil Permeability: Assoc. Engineering Geologists Ann. Mtg., Oct. 1-5, 1990, Pittsburgh, PA (abstr) p. 90.

II. Geology

a) Singler, C.R. & Picard, M.D., 1981, Paleosols in the Oligocene of northwest Nebraska: Contributions to Geology, v. 20, p. 57-68.

b) _____,& _____, 1980 Stratigraphic review of Oligocene beds in northern Great Plains: Earth Science Bulletin, v. 13, p. 1-18.

Ronald G. Tabak
Professor
Department of Physics & Astronomy
Youngstown State University
Youngstown, OH 44555

(330) 742-3618
Fax (330) 742-3121

EDUCATION

1976 Ph.D. in Astronomy, The Ohio State University
1969 M.S. in Physics, University of Washington
1968 B.S. in Physics, Youngstown State University

PROFESSIONAL POSITIONS

1987 - present	Professor, Physics & Astronomy
1984 - 1987	Associate Professor, YSU
1978 - 1984	Assistant Professor, YSU
1976 - 1978	Instructor, YSU

OTHER RELATED EXPERIENCE

1982 - 1990	Member of Executive Committee, Ohio Section, American Physical Society
1982 - 1983	Vice-Chair, Ohio Section, A.P.S.
1983 - 1985	Chair, Ohio Section, A.P.S.
1970 - 1972	Physical Science Assistant, U.S. Army Aeromedical Research Laboratory
1971 - 1972	Instructor (part time), Troy State University

PROFESSIONAL SOCIETIES

Memberships:

American Astronomical Society
American Physical Society
Ohio Section, A.P.S.; Chairman: 1983-85
Sigma Xi; President, YSU Chapter - 1985

Meeting Chair

1979 - Ohio Section, APS
1987 - Ohio Section, APS
1979, 81, 84, 87, 91, 94 - chaired paper sessions for OS/APS
1985, 89, 92 - Nominating Committee, OS/APS

HONORS

Youngstown State University, Distinguished Professor Award:83, 93
YSU-OEA: Distinguished Service Award: 87, 95

FIVE MOST RELEVANT PUBLICATIONS

1. "Gravity on a Half Shell" - R.G.Tabak: *Amer. J. Phys.* **55** (12), 1096-1098 (1987).

2. "Student Misconceptions of Newtonian Gravity" - R.G.Tabak: *Bull.Amer.Phys.Soc.* **32**, 1295 (1987)

3. "Creation Science: The Threat to Physics and Astronomy" - R.G.Tabak: *Bull.Amer.Phys.Soc.* **31**, 1116 (1986)

4. "Dark Ray Craters on Ganymede" - W.M.Young and R.G.Tabak: *Bull.Amer.Phys.Soc.* (1990)

5. "Cometary Collisions and the Dark Material on Iapetus" - R.G.Tabak and W.M.Young: *Earth, Moon and Planets* **44**, 251-264 (1989)

FIVE OTHER SIGNIFICANT PUBLICATIONS

1. "Monte Carlo Simulation of Temperature Fluctuations in Interstellar Iron Grains" - R.G.Tabak: *Astrophys. Space Sci.* **134**, 145-152 (1987)

2. "Interstellar Catalysis I. The Theory of H_2 Formation" - R.G.Tabak: *Astrophys Space Sci.* **53**, 279-294 (1978).

3. "Interstellar Catalysis II. Comparison of the Theory of H_2 Formation with Observation" - R.G.Tabak: *Astrophys.Space Sci.* **54**, 211-232 (1978)

4. "Correlations Between Enhanced Metal Depletions and Interstellar H_2 Abundance' - R.G.Tabak: *Nature* **269**, 582-583 (1977).

5. "The Nucleation and Expulsion of Carbon Particles Formed in Stellar Atmospheres" - R.G.Tabak, J.P.Hirth, G. Meyrick, and T.P.Roark: *Astrophys. J.* **196**. 457-463 (1975)

Graduate Advisor: Dr. Stanley J. Czyzak, Professor Emeritis of Astronomy, The Ohio State University

Biographical Sketch for John Daily Usis

A. Vitae

Education

Ph. D. 1990	Kent State University, Kent, Ohio Dissertation: *The Effects of Surface Mining on the Caddisflies (Trichoptera) of Stillfork Swamp*; Advisor:Prof. B.A. Foote
M. S. 1985	Youngstown State University, Youngstown, Ohio Thesis: *The Caddisflies (Trichoptera) of Stillfork Swamp Nature Preserve, Carrol Co., Ohio.* Advisor: Prof. D. B. MacLean
B. S. 1971	University of California, Berkeley, California B. S., Agricultural Sciences.

Summary of Experience

9/96 - Present.

Full Service Faculty Appointment
Youngstown State University
Department of Biological Sciences, One University Plaza, Younstown, Ohio
Associate Professor ; Instructor for the following:
Biol. 977 Introduction to Undergraduate Laboratory Supervising. (2 Cr Hrs)
Biol. 972 Systematic Zoology (3 CrHrs)
Biol. 954 Advanced Ecology (4 Cr Hrs)
Biol. 861 Sociobiology (3 CrHrs)
Biol. 803 Population and Community Ecology + Laboratory (5 CrHrs)
Biol. 780 Introduction to Ecology + Laboratory (5 CrHrs)
Biol. 710 Mammalian Anatomy (4 CrHrs).
Biol. 552 Human Anatomy and Physiology II. (4 CrHrs) + Multiple Lab Secs
Biol. 551 Human Anatomy and Physiology I. (4 CrHrs) + Multiple Lab Secs
Biol. 510 Principles of Biology II CrHrs) + Multiple Laboratory Sections. previously BIO508
Biol. 509 Principles of Biology I (4 CrHrs) + Multiple Laboratory Sections. previously BIO506
Biol. 505. Biology and the Modern World. (4CrHrs)
ENST 750 Seminars in Environmental Studies (1 Cr Hr)
ENST 601 Fundamental of Environmental Science (4CrHrs)
ENST 510 Field Trips in Environmental Studies (1 Cr Hr)

9/86- 12/90

Limited Service Faculty Appointments
Youngstown State University -
Instructor - BIO551 & BIO552 Anatomy and Physiology I & II
Kent State University (Trumbull Campus)
Instructor - BSCI20020 Structure and Function (Fall 1990)

Public Secondary Education Experience
Ohio Certification #CB 1853965 (grades 7-12)
Leetonia Exempted Schools: Substitute Teacher 1987-90
Salem High School: Substitute Teacher 1987-89
Columbiana Middle and High Schools (7-12): Substitute Teacher 1987-88
Boardman High School: Substitute Teacher 1987-89

Professional Affiliations:

Phi Kappa Phi, Honorary Academic Society, membership since 1985;
Sigma Xi, Honorary Science Research Society, membership since 1991.;
Ohio Academy of Science, membership since 1986

Awards:

Recipient of College of Arts & Sciences, Master Teacher Award, May 1994.

B. Most relevant Publications:

(1) Textbook:
Biology 509 Principle I Laboratory Manual, Getting Reacquainted with Science, 1996, Burgess International Group, Inc., Edina, Minnesota, ISBN 0-8087-2127-5.

Five Other Significant Publications:

(2) 'Preliminary Report of Ground Beetles (Carabidae) of Stillfork Swamp Nature Preserve'. 1993, *Ohio Journal of Science*, 93:46.
(3) 'Ground beetles (Coleoptera:Carabidae) of Eastern Ohio Forests threatened by Gypsy Moth Lymantria dispar (L.) (Lepidoptera:Lymantridae)', 1992, *Ohio Journal of Science*, 92:46-50.
(4) 'Influence of strip-mining on the mortality of a wetland caddisfly, Limnephilus indivisus (Trichoptera:Limnephilidae)', 1991, *The Great Lakes Entomologist*, 24:133-143.
(5) 'New Records of caddisflies (Trichoptera) from Ohio, with particular reference to Stillfork Swamp, Carroll County', March & April, 1989, *Entomological News*, Vol. 100(2)
(6) 'Comparison of the Caddisfly Fauna (Trichoptera) of Glaciated and Nonglaciated Lentic Sites in Eastern Ohio', March, 1986, *Ohio Journal of Science*, Vol. 86(1)

C. Other Collaborations:

Co-Participant:

1997-8	$27,000 PACER Project:Mahoning River Basin Research Program Youngstown State Univserity, Graduate School Funding, consulting ecologist

Co-PIs:

1996-95	$15,000 from Ohio Department of Natural Resources to Dr. B. Armitage, Ohio Biological Survey and Drs. D. MacLean and J. Usis, Youngstown State University for Ohio Trichoptera Survey, Watershed Region SE
1994-5	$15,000 from Ohio Department of Natural Resources to Dr. B. Armitage, Ohio Biological Survey and Drs. D. MacLean and J. Usis, Youngstown State University for Ohio Trichoptera Survey, Watershed Region NE.
1993-94	$11,000 from Ohio Department of Natural Resources to Dr. B. Armitage, Ohio Biological Survey and Drs. D. MacLean and J. Usis, Youngstown State University for Ohio Trichoptera Survey, Watershed Region SW.

D. Graduate Advisees:

Narmin Asri	Master Thesis 1995 "Effects of Indole-3-butyric Acid on *Glycine max* Germination."

E. Advisor:

Benjamin A. Foote (Dissertation Advisor) Kent State University, Kent, Ohio

YEAR 1

SUMMARY PROPOSAL BUDGET

FOR NSF USE ONLY

ORGANIZATION: Youngstown State University

PROPOSAL NO. | DURATION (MONTHS) Proposed | Granted

PRINCIPAL INVESTIGATOR/PROJECT DIRECTOR: Dr. John D. Usis

AWARD NO.

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF-Funded Person-months CAL	ACAD	SUMR	Funds Requested By Proposer	Funds Granted By NSF (If Different)
1. Dr. John D. Usis, Principal Investigator			1	$ 4,492	$
2. Dr. James H. Andrews, Co-investigator			½	2,252	
3. Dr. William R. Buckler, Co-investigator			½	2,394	
4. Dr. Allen Hunter, Co-investigator			½	2,650	
5. Dr. Alan M. Jacobs, Co-investigator			½	2,610	
6. (5) OTHERS (LIST INDIVIDUALLY ON BUDGET EXPLANATION PAGE)			2½	14,864	
7. (10) TOTAL SENIOR PERSONNEL (1-6)			5½	29,762	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. ( ) POST DOCTORAL ASSOCIATES					
2. ( ) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)					
3. ( ) GRADUATE STUDENTS					
4. ( ) UNDERGRADUATE STUDENTS					
5. ( ) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)					
6. ( ) OTHER					
TOTAL SALARIES AND WAGES (A+B)				29,762	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				5,357	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A+B+C)				35,119	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT					
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)					
2. FOREIGN					
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $					
2. TRAVEL					
3. SUBSISTENCE					
4. OTHER					
( ) TOTAL PARTICIPANT COSTS					
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				5,952	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION					
3. CONSULTANT SERVICES				6,000	
4. COMPUTER SERVICES					
5. SUBAWARDS					
6. OTHER					
TOTAL OTHER DIRECT COSTS				11,952	
H. TOTAL DIRECT COSTS (A THROUGH G)				47,071	
I. INDIRECT COSTS (SPECIFY RATE AND BASE) 42% S & W					
TOTAL INDIRECT COSTS				12,500	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				59,571	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECT SEE GPG II.D.7.j.)				---	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ 59,571	$

M. COST-SHARING: PROPOSED LEVEL $ 66,800 | AGREED LEVEL IF DIFFERENT $

PI/PD TYPED NAME & SIGNATURE*	DATE	FOR NSF USE ONLY INDIRECT COST RATE VERIFICATION		
ORG. REP. TYPED NAME & SIGNATURE*	DATE	Date Checked	Date of Rate Sheet	Initials-ORG

NSF Form 1030 (7/95) *Supersedes All Previous Editions*

*SIGNATURES REQUIRED ONLY FOR REVISED BUDGET (GPG III.B)

YEAR 2

SUMMARY PROPOSAL BUDGET

FOR NSF USE ONLY

ORGANIZATION: Youngstown State University

PROPOSAL NO. | DURATION (MONTHS) Proposed | Granted

PRINCIPAL INVESTIGATOR/PROJECT DIRECTOR: Dr. John D. Usis

AWARD NO.

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF-Funded Person-months CAL	ACAD	SUMR	Funds Requested By Proposer	Funds Granted By NSF (If Different)
1. Dr. John D. Usis, Principal Investigator			1	$ 5,142	$
2. Dr. James H. Andrews, Co-investigator			1/2	2,320	
3. Dr. William R. Buckler, Co-investigator			1/2	2,466	
4. Dr. Allen Hunter, Co-investigator			1/2	2,728	
5. Dr. Alan M. Jacobs, Co-investigator			1/2	2,688	
6. (5) OTHERS (LIST INDIVIDUALLY ON BUDGET EXPLANATION PAGE)			2 1/2	15,310	
7. (10) TOTAL SENIOR PERSONNEL (1-6)			10 1/2	30,654	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. ( ) POST DOCTORAL ASSOCIATES					
2. ( ) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)					
3. ( ) GRADUATE STUDENTS					
4. ( ) UNDERGRADUATE STUDENTS					
5. ( ) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)					
6. ( ) OTHER					
TOTAL SALARIES AND WAGES (A+B)				30,654	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				5,518	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A+B+C)				36,172	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT					
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)					
2. FOREIGN					
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $					
2. TRAVEL					
3. SUBSISTENCE					
4. OTHER					
( ) TOTAL PARTICIPANT COSTS					
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				6,131	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION					
3. CONSULTANT SERVICES				6,000	
4. COMPUTER SERVICES					
5. SUBAWARDS					
6. OTHER					
TOTAL OTHER DIRECT COSTS				12,131	
H. TOTAL DIRECT COSTS (A THROUGH G)				48,303	
I. INDIRECT COSTS (SPECIFY RATE AND BASE) 42% S & W					
TOTAL INDIRECT COSTS				12,875	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				61,178	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECT SEE GPG II.D.7.j.)				---	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ 61,178	$

M. COST-SHARING: PROPOSED LEVEL $ 66,800 | AGREED LEVEL IF DIFFERENT $

PI/PD TYPED NAME & SIGNATURE*	DATE	FOR NSF USE ONLY INDIRECT COST RATE VERIFICATION		
ORG. REP. TYPED NAME & SIGNATURE*	DATE	Date Checked	Date of Rate Sheet	Initials-ORG

NSF Form 1030 (7/95) *Supersedes All Previous Editions*

*SIGNATURES REQUIRED ONLY FOR REVISED BUDGET (GPG III.B)

YEAR 3

SUMMARY PROPOSAL BUDGET

FOR NSF USE ONLY

PROPOSAL NO. | DURATION (MONTHS) Proposed | Granted

ORGANIZATION: Youngstown State University

PRINCIPAL INVESTIGATOR/PROJECT DIRECTOR: Dr. John D. Usis

AWARD NO.

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF-Funded Person-months CAL	ACAD	SUMR	Funds Requested By Proposer	Funds Granted By N (If Different
1. Dr. John D. Usis, Principal Investigator			1	$ 5,296	$
2. Dr. James H. Andrews, Co-investigator			1/2	2,390	
3. Dr. William R. Buckler, Co-investigator			1/2	2,540	
4. Dr. Allen D. Hunter, Co-investigator			1/2	2,810	
5. Dr. Alan M. Jacobs, Co-investigator			1/2	2,768	
6. (5) OTHERS (LIST INDIVIDUALLY ON BUDGET EXPLANATION PAGE)			2 1/2	15,768	
7. (10) TOTAL SENIOR PERSONNEL (1-6)			5 1/2	31,572	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. ( ) POST DOCTORAL ASSOCIATES					
2. ( ) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)					
3. ( ) GRADUATE STUDENTS					
4. ( ) UNDERGRADUATE STUDENTS					
5. ( ) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)					
6. ( ) OTHER					
TOTAL SALARIES AND WAGES (A+B)				31,572	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				5,683	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A+B+C)				37,255	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT					
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)					
2. FOREIGN					
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $					
2. TRAVEL					
3. SUBSISTENCE					
4. OTHER					
( ) TOTAL PARTICIPANT COSTS					
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				6,315	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION					
3. CONSULTANT SERVICES				6,000	
4. COMPUTER SERVICES					
5. SUBAWARDS					
6. OTHER					
TOTAL OTHER DIRECT COSTS				12,315	
H. TOTAL DIRECT COSTS (A THROUGH G)				49,570	
I. INDIRECT COSTS (SPECIFY RATE AND BASE) 42% S & W					
TOTAL INDIRECT COSTS				13,260	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				62,830	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECT SEE GPG II.D.7.j.)				---	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ 62,830	$

M. COST-SHARING: PROPOSED LEVEL $ 66,800 | AGREED LEVEL IF DIFFERENT $

PI/PD TYPED NAME & SIGNATURE*	DATE	FOR NSF USE ONLY INDIRECT COST RATE VERIFICATION
ORG. REP. TYPED NAME & SIGNATURE*	DATE	Date Checked | Date of Rate Sheet | Initials-ORG

NSF Form 1030 (7/95) *Supersedes All Previous Editions*

*SIGNATURES REQUIRED ONLY FOR REVISED BUDGET (GPG III.B)

TOTAL PROJECT

SUMMARY PROPOSAL BUDGET

FOR NSF USE ONLY

ORGANIZATION: Youngstown State University

PROPOSAL NO. | DURATION (MONTHS) Proposed | Granted

PRINCIPAL INVESTIGATOR/PROJECT DIRECTOR: Dr. John D. Usis

AWARD NO.

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF-Funded Person-months CAL	ACAD	SUMR	Funds Requested By Proposer	Funds Granted By NSF (If Different)
1. Dr. John D. Usis, Principal Investigator			3	$ 15,430	$
2. Dr. James H. Andrews, Co-investigator			1½	6,962	
3. Dr. William R. Buckler, Co-investigator			1½	7,400	
4. Dr. Allen D. Hunter, Co-investigator			1½	8,188	
5. Dr. Alan M. Jacobs, Co-investigator			1½	8,066	
6. (5) OTHERS (LIST INDIVIDUALLY ON BUDGET EXPLANATION PAGE)			7½	46,046	
7. (10) TOTAL SENIOR PERSONNEL (1-6)			16½	91,988	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. ( ) POST DOCTORAL ASSOCIATES					
2. ( ) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)					
3. ( ) GRADUATE STUDENTS					
4. ( ) UNDERGRADUATE STUDENTS					
5. ( ) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)					
6. ( ) OTHER					
TOTAL SALARIES AND WAGES (A+B)				91,988	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				16,558	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A+B+C)				108,546	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT					
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)					
2. FOREIGN					
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $					
2. TRAVEL					
3. SUBSISTENCE					
4. OTHER					
( ) TOTAL PARTICIPANT COSTS					
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				18,398	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION					
3. CONSULTANT SERVICES				18,000	
4. COMPUTER SERVICES					
5. SUBAWARDS					
6. OTHER					
TOTAL OTHER DIRECT COSTS				36,398	
H. TOTAL DIRECT COSTS (A THROUGH G)				144,944	
I. INDIRECT COSTS (SPECIFY RATE AND BASE) 42% S & W					
TOTAL INDIRECT COSTS				38,635	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				183,579	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECT SEE GPG II.D.7.j.)				---	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ 183,579	$

M. COST-SHARING: PROPOSED LEVEL $ 200,400 | AGREED LEVEL IF DIFFERENT $

PI/PD TYPED NAME & SIGNATURE*	DATE	FOR NSF USE ONLY INDIRECT COST RATE VERIFICATION
ORG. REP. TYPED NAME & SIGNATURE*	DATE	Date Checked | Date of Rate Sheet | Initials-ORG

NSF Form 1030 (7/95) *Supersedes All Previous Editions*

*SIGNATURES REQUIRED ONLY FOR REVISED BUDGET (GPG III.B)

PROJECT BUDGET (ESTIMATED)

July 1, 1998 - June 30, 2001

PERSONNEL	NSF YEAR 1	NSF YEAR 2	NSF YEAR 3	NSF TOTAL
J. USIS, PRINCIPAL INVESTIGATOR 50% summers (2/9 mos.) @ $44,934/ 9 mos. [acad. year 1998-9 salary, based on current salary plus standard union-negotiated agreement; subsequent years include 3% annual inflation factor] to be determined: acad. year level of effort (cost estimated)	4,992	5,142	5,296	15,430
J. ANDREWS, CO-INVESTIGATOR 25 % summers (2/9 mos.) @ $40,537/ acad. year. This and all succeeding salary calculations are based on the above.	2,252	2,320	2,390	6,962
W. BUCKLER, CO-INVESTIGATOR 25% summers (2/9 mos.) @ $43,087/ acad. year	2,394	2,466	2,540	7,400
A. HUNTER, CO-INVESTIGATOR 25% summers (2/9 mos.) @ $47,685/ acad. year	2,650	2,728	2,810	8,188
A. JACOBS, CO-INVESTIGATOR 25% summers (2/9 mos.) @ $46,964/ acad. year	2,610	2,688	2,768	8,066
H. LORIMER, CO-INVESTIGATOR 25% summers (2/9 mos.) @ $40,536/ acad. year	2,252	2,320	2,389	6,961
S. LOVELACE-CAMERON, CO-INVEST. 25% summers (2/9 mos.) @ $40,740/ acad. year	2,263	2,331	2,401	6,995
R.B. MATTINGLY, CO-INVESTIGATOR 25% summers (2/9 mos.) @ $51,098/ 12 mos.	2,838	2,924	3,012	8,774
C. SINGLER, CO-INVESTIGATOR 25% summers (2/9 mos.) @ $74,108/ 12 mos.	4,118	4,240	4,366	12,724

PERSONNEL (cont.)	NSF YEAR 1	NSF YEAR 2	NSF YEAR 3	TOTAL
R. TABAK, CO-INVESTIGATOR 25% summers (2/9 mos.) @ $61,099/ acad. year	3,393	3,495	3,600	10,488
SUBTOTAL	29,762	30,654	31,572	91,988
FRINGE BENEFITS				
Retirement (STRS) @ 13.70% + Worker's Compensation + Unemployance Allowances = 18% S/W (Flat Rate)	5,357	5,518	5,683	16,558
MATERIALS + SUPPLIES				
Current best estimate of costs associated with instructional course development including photocopying, software, lab supplies, library materials, and monthly L.D. telephone charges including 3% inflation factor	5,952	6,131	6,315	18,398
EVALUATION				
Consultant fees & related expenses for (1) external evaluator @ $350/day + $50/day expenses x 15 days/year	6,000	6,000	6,000	18,000
DIRECT COSTS	47,071	48,303	49,570	144,944
INDIRECT COSTS @ 42% S/W	12,500	12,875	13,260	38,635
TOTAL SPONSOR CHARGE	**59,571**	**61,178**	**62,830**	**183,579**
YSU Contribution for Computers, Software, Travel, etc.	10,000	10,000	10,000	30,000
Faculty Release Time for Curriculum/ Course Development	40,000	40,000	40,000	120,000
Unrecovered Indirect Costs	16,800	16,800	16,800	50,400
TOTAL YSU MATCH	**66,800**	**66,800**	**66,800**	**200,400**

BUDGET JUSTIFICATION:

To implement the proposed broad-based reform of general science education at Youngstown State University, it is necessary to have at least one person involved from each of the science departments. Two faculty are included from the larger departments that are expected to assume a greater share of the teaching load for the general education science courses.

The following list indicates the faculty that will be primarily responsible for developing the investigative laboratories and reforming the other general science offerings in their departments: Ronald Tabak, Astronomy; Heather Lorimer and John Usis, Biological Sciences; Allen Hunter and Sherri Lovelace-Cameron, Chemistry; Alan Jacobs, Environmental Studies; William Buckler, Geography; Charles Singler, Geology; James Andrews, Physics. Bruce Mattingly, Mathematics & Statistics, will work with the other investigators on integrating mathematical content into the proposed courses. As principal investigator, John Usis will also handle grant administration duties in addition to course development in Biology.

An external consultant with science background and social science research skills will be identified to conduct an independent evaluation of the project. This consultant will be responsible for developing and overseeing the administration of appropriate evaluation instruments, observing classes, consulting with faculty, summarizing data, making recommendations and contributing to final report preparation.

Youngstown State University will provide cost sharing adequate to support the overall project effort. Specifically, the College of Arts & Sciences is allocating up to $40,000 per year in faculty release ("University Reassigned Time) support for those faculty involved in project implementation, as well as $16,800 in unrecovered indirect costs associated with this faculty contribution, based on the University's standing DHHS indirect cost agreement. A further annual allocation of up to $10,000 in materials & supplies and related purchased services brings the total annual cost sharing to $66,800 or a cumulative University contribution of $200,400.

Current and Pending Support

(See GPG Section II.D.8 for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this propo[sal]

Investigator: James H. Andrews

Other agencies (including NSF) to which this proposal has been/will be submitted. none

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: NONE

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Current and Pending Support

(See GPG Section II.D.8 for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposa

Investigator: William Buckler

Other agencies (including NSF) to which this proposal has been/will be submitted. None

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

NONE

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Current and Pending External Support for Dr. Allen D. Hunter

See GPG Section II.D.8 for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Dr. Allen D. Hunter	Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Acquisition of a Single Crystal X-ray Diffractomer, $238,000 in total
with T. R. Wagner*, J. A. Jackson, andR. E. Beiersdorfer

Source of Support: NSF-DMR + Ohio Board of Regents Action Fund (CAP-098)

Total Award Amount: $71,199 + 60,000 Total Award Period Covered: 1994-96

Location of Project: Youngstown State University

Person-Months Per Year Committed to the Project. ***completed*** Cal: Acad: Sumr:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Integration of GC-MS into the Undergraduate Curriculum
with J. A. Jackson*, S. M. Schildcrout, R. L. Falconer, and T. R. Wagner

Source of Support: NSF-ILI-IP

Total Award Amount: $34,450 Total Award Period Covered: 1995-96

Location of Project: Youngstown State University

Person-Months Per Year Committed to the Project. ***completed*** Cal: Acad: Sumr:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Ohio Crystallography Consortium at Toledo, $815,000 in total with J. E. Gano* and many others. Includes Funds to Purchase the three Silicon Graphics INDY Workstations in YSU's X-Ray Crystallography Lab

Source of Support: Ohio Board of Regents Investment Fund (CAP-075)

Total Award Amount: $35,000 for YSU Total Award Period Covered:

Location of Project: University of Toledo, Youngstown State University

Person-Months Per Year Committed to the Project. ***completed*** Cal: Acad: Sumr:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Ohio NMR Consortium, $3,000,000 in total with M-D Tsai and others. Includes Funds to Upgrade of YSU's 400 MHz NMR, Including: PFG Module, Inverse Detection and Quad PFG Probes, Anti-Vibration System, and Robotic Sample Changer, and to upgrade the instructional 60 MHz NMR

Source of Support: Ohio Board of Regents Investment Fund (CAP-419)

Total Award Amount: $ 200,000 for YSU Total Award Period Covered: 1995-96

Location of Project: Ohio State University, Youngstown State University, etc.

Person-Months Per Year Committed to the Project. Cal: 2 Acad: Sumr:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Computer Aided Instruction in the Department of Chemistry at Youngstown State University
with J. A. Jackson* and three others

Source of Support: OBoR

Total Award Amount: ≈.$100,000 Total Award Period Covered: 1997-98

Location of Project: Youngstown State University

Person-Months Per Year Committed to the Project. Cal: 3 Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Current and Pending Support

See GPG Section II.D.8 for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Alan Jacobs

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: x Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Environmental Investigative Laboratory

Source of Support: NSF-ILI DUE-9552347

Total Award Amount: $25,000 Total Award Period Covered: 1995-97, extension to 1998

Location of Project: Youngstown State University

Person-Months Per Year Committed to the Project. Cal: 2 Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Current and Pending Support

See GPG Section II.D.8 for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Heather Lorimer

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

None

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Current and Pending Support

See GPG Section II.D.8 for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Sheri Lovelace-Cameron	Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

None

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Current and Pending Support

See GPG Section II.D.8 for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Bruce Mattingly

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

None

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Current and Pending Support

(See GPG Section II.D.8 for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this propos

Investigator: Charles Singler

Other agencies (including NSF) to which this proposal has been/will be submitted. None

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

NONE

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Current and Pending Support

(See GPG Section II.D.8 for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposa

Investigator: Ronald G. Tabak

Other agencies (including NSF) to which this proposal has been/will be submitted. None

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: NONE

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Current and Pending Support

(See GPG Section II.D.8 for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: John D. Usis

Other agencies (including NSF) to which this proposal has been/will be submitted. None

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support: None

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

APPENDIX I. Facilities and Equipment

The laboratory space, scientific equipment and consumable laboratory supplies that will be required to develop and implement this grant project are already in place at Youngstown State University or will be available through current resources at the Departmental, College, and University levels. Detailed analysis of the requirements for this program have been evaluated by a committee including the Dean of Arts and Sciences and the Chairs of the appropriate departments. In most departments, suitable laboratory space which will be allocated to this project is already in place. Where required, these facilities will be modified to better meet the needs of the proposed collaborative courses. Based on our experiences with analogous courses for our science majors, we do not expected that the proposed investigative courses will require a substantial investment in facilities beyond that required for conventional labs. In cases where more specialized facilities may be required, these have already been funded through previous NSF and Ohio Board of Regents grants (see above) or they will be funded through internal resources.

YSU

Youngstown State University / One University Plaza / Youngstown, Ohio 44555-340
The College of Arts and Science
Office of the Dea
(330) 742-340
FAX (330) 742-230

October 13, 1997

To: NSF

From: Barbara Brothers, Dean College of Arts and Sciences

Subject: YSU Grant for Developing an Investigative Science Laboratory and Revising Science General Education courses

For the next three years, the College of Arts and Sciences is dedicating its teaching enhancement funds ($18,000 per year) and faculty development reassigned time to support 1) the development of courses to be cross-listed between 2 or more departments, 2) the redesign of curricula based upon a review of the knowledge, skills, and abilities students will need in the future and who are ready to begin that process now, and 3) pedagogical innovations, particularly those employing technology in the classroom. In the past, teaching enhancement funds have been used to sponsor workshops and conferences, for travel involving teaching improvement or presentations of teaching innovations, and to support faculty initiatives having significance for more than individual classes.

Support for teaching innovation also comes from the OEA Contract. The faculty contract is generous in supporting team teaching: "A minimum of six (6) students per professor must register for any courses taught by two (2) or more professors. If the registration ranges from 6 to 9 students per professor, each faculty member shall be allotted one (1) TH for two (2) contact hours. If the registration ranges from ten (10) to fourteen (14) students per professor, the faculty member shall be allotted two (2) TH for three (3) contact hours. If the registration exceeds fourteen (14) students per professor, the faculty member shall be allotted one (10 TH for one (1) contact hour." In addition, the University encourages the Dean to grant exceptions to the minimums the first time a class is taught.

Other resources that the College will use to support the project in reaching its goals include funds for all faculty in the sciences to upgrade their computers where necessary to support the software being used in their classrooms.

While these college resources are not exclusively for the science investigative lab development, **first priority will be given to the needs of the project**.

The College of Arts and Sciences provides forums for the dissemination of the results--Quest (YSU student and faculty scholarship day), *The Art and Science of Teaching*, and the new Arts and Sciences Community Partners, a 14-member advisory board of leaders of government, business, medicine, and law from the region. The College Master Teachers has also provided a forum for the last four years to encourage and support innovations in teaching and curriculum and discussion of effective strategies to improve student learning. Faculty rewards go to those whose teaching, scholarship, and service further the goals and mission of the department and college. Thus the College provides the intellectual and professional environment that is the germinating ground for the curricular reform evident in those NSF grants we have gotten in the last four years.