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, division, etc.)
Division of Undergraduate Education
Instrument and Laboratory Improvement

PROGRAM ANNOUNCEMENT/SOLICITATION NO./CLOSING DATE
EHR/DUE ILI-IP (NSF #93-164) November 14, 1994

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NSF PROPOSAL NUMBER

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 FEDERAL 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:
410 Wick Avenue
Youngstown, Ohio 44555

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 For Definitions)
☐ FOR PROFIT ORGANIZATION ☐ SMALL BUSINESS ☐ MINORITY BUSINESS ☐ WOMAN-OWNED BUSINE

TITLE OF PROPOSED PROJECT:
An Investigative Science Laboratory

REQUESTED AMOUNT	PROPOSED DURATION (1-60 MONTHS)	REQUESTED STARTING DATE:
$ 49,300.00	18 months	July 1, 1995

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

☐ VERTEBRATE ANIMALS
☐ HUMAN SUBJECTS
☐ HISTORICAL PLACES
☐ BEGINNING INVESTIGATOR (See GPG SECTION I)
☒ GROUP PROPOSAL
☐ SMALL GRANT FOR EXPLORATORY RESEARCH (SGER) (SEE GPG SECTION II. C. 12)
☐ NATIONAL ENVIRONMENTAL POLICY ACT
☐ PROPRIETARY AND PRIVILEGED INFORMATION
☐ DISCLOSURE OF LOBBYING ACTIVITIES
☐ FACILITATION FOR SCIENTISTS/ENGINEERS WITH DISABILIT
☐ RESEARCH OPPORTUNITY AWARD
☐ INTERNATIONAL COOPERATIVE ACTIVITY:
Country/countries

PI/PD DEPARTMENT
Center for Environmental Studies

PI/PD FAX NUMBER
(216) 742-1483

PI/PD POSTAL ADDRESS
410 Wick Avenue
Youngstown, Ohio 44555

NAMES (TYPED)	Social Security No.*	High Degree, Yr	Telephone Number	Electronic Mail Address
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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.

CERTIFICATION PAGE

Certification for Principal Investigators and Co-Principal Investigators:

I certify to the best of my knowledge that:

(1) the statements herein (excluding scientific hypotheses and scientific opinions) are true and complete, and
(2) the text and graphics herein as well as any accompanying publications or other documents, unless otherwise indicated, are the original work of the signatories or individuals working under their supervision. I agree to accept responsibility for the scientific conduct of the project and to provide the required progress reports if an award is made as a result of this application.

I understand that the willful provision of false information or concealing a material fact in this proposal or any other communication submitted to NSF is a criminal offense (U.S.Code, Title 18, Section 1001).

Name (Typed)	Signature	Date
PI/PD Lauren Schroeder	Lauren Schroeder	11/8/94
Co-PI/PD Daryl Mincey	Daryl W. Mincey	11/9/94
Co-PI/PD Scott Martin	Scott C. Martin	11/9/94
Co-PI/PD Jeff Dick	Jeff Dick	11/9/94
Co-PI/PD		

Certification for Authorized Institutional Representative or Individual Applicant:

By signing and submitting this proposal, the individual applicant or the authorized official of the applicant institution is: (1) certifying that statements made herein are true and complete to the best of his/her knowledge; and (2) agreeing to accept the obligation to comply with NSF award terms and conditions if an award is made as a result of this application. Further, the applicant is hereby providing certifications regarding Federal debt statue, debarment and suspension, drugfree workplace, and lobbying activities (see below), as set forth in the Grant Proposal Guide (GPG), NSF 94-2. Willful provision of false information in this application and its supporting documents or in reports required under an ensuing award is a criminal offense (U.S. Code, Title 18, Section 1001).

Debt and Debarment Certifications

(If answer "yes" to either, please provide explanation.)

Is the organization delinquent on any Federal debt? Yes___ No X

Is the organization or its principals presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency? Yes___ No X

Certification Regarding Lobbying

This certification is required for an award of a Federal contract, grant, or cooperative agreement exceeding $100,000 and for an award of a Federal loan or a commitment providing for the United States to insure or guarantee a loan exceeding $150,000.

Certification for Contracts, Grants, Loans and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

AUTHORIZED INSTITUTIONAL REPRESENTATIVE	SIGNATURE	DATE
NAME/TITLE (TYPED) Dr. Leslie H. Cochran, President		

TELEPHONE NUMBER	ELECTRONIC MAIL ADDRESS	FAX NUMBER
(216) 742-3101		(216) 742-1579

NATIONAL SCIENCE FOUNDATION
Division of Undergraduate Education

PROJECT DATA FORM

The instructions and codes to be used in completing this form begin on the next page.

1. Program to which the Proposal is Submitted: ILI-IP

2. Type of Submission: PR

3. Name of Principal Investigator/Project Director (as shown on the Cover Sheet):
   Dr. Lauren Schroeder

4. Name of Submitting Institution (as shown on the Cover Sheet)
   Youngstown State University

5. Other institutions involved in the project's operation:
   None

PROJECT CODES

A. Major Discipline Code: 6 1 Subfields: Chemistry, Geology

B. Academic Focus Level of Project: L O

C. Highest Degree Code: D

D. Category Code: _ _

E. Business/Industry Participation Code: _ _

F. Audience Code: _ _ _ _

G. Institution Code: P U B L

H. Environmental Education Code: E N

J. Estimated Number of Undergraduate Students to be Directly Affected by the Activities of the Project During its Operation: 500 over 4 years

K. Estimated Number of Pre-college Students to be Directly Affected by the Activities of the Project During its Operation: 12 over 4 years

L. Estimated Number of College Faculty to be Directly Affected by the Activities of the Project During its Operation: _____

M. Estimated Number of Pre-college Teachers to be Directly Affected by the Activities of the Project During its Operation: _____

N. Total Non-NSF Contribution: $49,300

Project Summary:

The Project Summary should be a concise description of the project limited to 22 lines of 12-point (standard pica type) or larger font on plain white paper.

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Project Summary

Methods of scientific investigation will be taught in an investigatory laboratory setting. Students, working in teams, will design methods for determining sources of variability in data resulting from measurements using balances, spectrophotometers and dissolved oxygen probes. Each research team will also identify and delineate a specific problem whose investigation is tractable with available instruments and consistent with student's skills. The teams will identify possible solutions to the problem, select one or more solutions for testing, devise an empirical test using available instruments, do the experiments, analyze the data and draw appropriate conclusions. The projects will b presented both in written and oral formats to all members of the class.

The intended outcomes from this laboratory are: (1) improved skills in critical thinking and problem solving, (2) better understanding and appreciation of science, (3) improved communication and teamwork skills, (4) understanding simple statistical methods, (4) enhanced skill in obtaining electronically accessed data, (5) enhanced attitude towards science.

a. CURRENT SITUATION:

Youngstown State University is a regional urban institution serving students from northeastern Ohio and northwestern Pennsylvania. The University is primarily an undergraduate institution with master level degree programs in 19 departments. There are about 10,000 full-time student equivalents from a total student enrollment of 14,000.

Students come from working class families. During most of this century, the primary service area of Youngstown State University was a major steel producing region. Since the close of much of the steel industry during the late 1970's and early 1980's, unemployment has been higher than the National average and remains among the highest in Ohio (over 8%). Consequently many YSU students are relatively poor and either work part time or obtain other assistance to fund their college education.

The Center for Environmental Studies was established by Youngstown State University in the Summer of 1994. The Center offers a BS degree program in Environmental Studies. It is an interdisciplinary program involving faculty from 16 different academic departments in four Colleges. The development of the Environmental Studies program was fostered by the successful implementation of an interdisciplinary Environmental Science Minor in 1990. The Environmental Studies program is the culmination of over two years research and work by a dedicated faculty committee. Members of the committee represent the University Departments of: Civil and Environmental Engineering, Geology, Chemistry, Biology, Geography, Allied Health and the YSU-Technology Development Coorporation. This committee continues to serve as an advisory board for the program.

The program has several unusual if not unique features. Although the curriculum draws heavily on existing courses in other departments there is a core of 30 quarter hours of environmental courses uniquely designed for the needs of environmental students. Many of these courses will be team taught. A common educational goal in all of the Environmental courses is development of skills in "critical thinking", communication, teamwork and computer use. The curriculum allows for specialization in one of four area: Environmental Science, Environmental Technology, Environmental Affairs or Environmental Health. The program attracts most of its students from the science disciplines of Chemistry, Biology and Geology. Students specializing in Environmental Science are expected to continue their education in graduate programs.

The program was developed with the participation of representatives from 10 two year colleges in northeastern Ohio. Articulation agreements with these colleges are being formulated to facilitate transfer of students, upon graduation from the two year programs, into the ES program at YSU. Also cooperative programs are being developed including common and cooperative courses.

YSU is in the process of modernizing it's electronic educational technology to provide multimedia, interactive classrooms and distant learning centers. The ES program will take

advantage of this technology to expand the interaction with area two year colleges.

The University's commitment to support the Environmental Studies Program is strong. The University, prior to the passage of the BS program proposal by the Ohio Board of Regents, had established the Center for Environmental Studies and appointed a Director. The Environmental Studies Program embodies and exemplifies the recently revised mission statement of the University (YSU Mission Statement, 1993). The University's mission delineates six "purposes" that are congruent with the Environmental Studies Program's goals.

(1) Environmental Studies students will be encouraged to participate in vertically integrated research projects. The program will foster research projects that involve undergraduate students, graduate students and faculty, in team structure research. (2) The laboratory course for which the ILI will be used, represents a new approach to science education at YSU. (3) Students from the Environmental Studies program will contribute to strengthening the connections between the University and the community by working as interns and coops (internships and cooperatives) as well on cooperative research projects with business and government. (4) An essential principle embodied in the Environmental Studies Program is that excellence in teaching is inseparable from research and scholarship. The Environmental Studies Program will promote the integration of teaching, research and service. The ILI will foster the integration of research and science education. (5) Essential to the education of environmental students is development of an appreciation of disparate opinions on complex environmental issues. To this end both students and faculty will be recruited who represent a wide range of backgrounds and experiences. (6) Inherent in the Environmental Studies program is productive interrelationships in research and teaching among faculty from a wide variety of departments in the University.

The University has made a strong commitment to these principles and to the programs, such as Environmental Studies, which embody these goals.

The Environmental Studies Program fills a rapidly growing niche in the University's program area. We anticipate that within three years there will be 400 Environmental Studies majors. For these and other reasons the University is strongly committed to the development of the Environmental Studies Program.

The university supports an Analytical Laboratory that provide analytical services for environmental and other research projects. The laboratory also provides education in instrumentation.

Other resources:

Personnel: Faculty for the Environmental Program will be drawn primarily from existing faculty. However, one new faculty position, 1/2 time in Civil and Environmental Engineering and 1/2 time in Environmental Studies is being filled. We anticipate that

during the next 4 years five positions will be added to the Environmental Studies Program. In support of the Environmental Program several recent additions to the faculty have been filled by Environmental Scientists:
Dr. Renee Falconer, Chemistry, research interest is in transport of organic compounds in the atmosphere.
Dr. Jeff Dick, Geology, Research interest in detection of environmental related subsurface anomalies.
Dr. Ray Beiersdorfer, Geology, Research interest in soil development, particularly in extraterrestrial planets.
The Department of Chemistry currently has an open position for which they are seeking a chemist with environmental interests.

These new and recently filled positions are supplemental to the existing core of environmental scientists already on the faculty:The faculty that will be directly involved with teaching the Fundamentals of Environmental Studies, the course for which this proposal is directed, include: Drs. Lauren Schroeder, Biology; Ray Biersdorffer, Geology; Jeff Dick, Geology, Bill Buckler, Geography, Scott Martin, Civil and Environmental Engineering, Renee Falconer, Chemistry, and Daryl Mincey, Chemistry. The Fundamentals course will be team taught with 3 or four faculty per quarter.

CURRICULAR DEFICIENCY

The current undergraduate science curricula at YSU does not include investigative laboratories. Most of the science courses for non-science majors do not include a laboratory.

Science is a method for how we come to know about ourselves and our environment. Too often, and this is true at Youngstown State University as well as most other Universities, science is depicted as a collection of facts rather than a method "facts" are discovered. Undergraduate laboratories, especially those for the non-science majors, tend to emphasis the scientific "facts" rather than the science. Many students complete their science requirements, and even science majors complete their science degrees, without experiencing the excitement of the discovery inherent in doing science. Even more disturbing is that students, science majors included, complete their science program without developing critical thinking skills. Many (most) of our undergraduate science laboratories exercises are caricatures of classical experiments. These are exercises that have a "right" answer, corresponding to the results of the classical experiment. If student's results are not what is expected, then the student is "wrong" and graded accordingly. The consequence of these types of laboratories is that students often learn that science is rigid, prescribed, and unexciting. There is little room in most of the current laboratories for imagination, invention and discovery (Sigma Xi, 1989).

The traditional science laboratory that repeats "classical" experiments or exersises that illustrate phenomenon serve to aid in teaching the "facts" and principles presented in lecture. They may

also help teach techniques and use of scientific instruments. However, they often fail to provide an opportunity for students to experience science, the process of discovery. Nor do these traditional laboratories provide the best situations for developing skills for problem delineation, experimental design or critical thinking. For some of these students a laboratory that challenges their curiosity, imagination and intellect may convince them to continue their careers in science.

Development of skills in critical thinking, communication, computers and teamwork are infused into the Environmental Studies curriculum. The money requested in this proposal is to develop a laboratory that will emphasis the development of these skill ares in our students.

DEVELOPMENT PLAN

We intend to use the Instrument and Laboratory Improvement grant to develop the laboratory for the introductory course in the Environmental Studies Program, Fundamentals of Environmental Studies (Appendix A). The Fundamentals course is a sophomore level laboratory course in the core curriculum of the Environmental Studies program. The course will have a "discovery" type laboratory that emphasis: the scientific method, data management, understanding of accuracy, precision, and error, critical thinking, teamwork and communication skills. Investigative laboratories of this type are new at YSU. We expect to use the results from this "experiment" to provide a model for additional investigatory laboratories for the General Science Requirement courses.

The goals of the laboratory are to improve student's:

1. critical thinking skills
2. teamwork skills
3. communication skills
4. skills in using statistics
5. skills in use of computers
5. understanding of and attitude toward science.
6. ability to apply the scientific method to problem solving

Specific objectives. Upon satisfactory completion of the laboratory students will:

1. understand variability due instrument error, technique error, and universe heterogeneity
2. understand the statistical procedures to determine likelihood of differences among means with overlapping variance, (student's t test, Oneway ANOVA etc)
3. learn to use an analytical balance, dissolved oxygen meter, and spectrophotometer
4. be able to discern and clearly delineate a problem that is suitable for testing with the available instrumentation
5. be able to develop a set of plausible hypotheses for the problem
6. be able to devise an experiment that will test one or more

of the plausible hypotheses
7. be able to draw logical conclusion from the data regarding the hypotheses
8. write a concise but detailed report of a research project

Pedagogy:

Students will work in teams of five. The teams will be selected by the instructor at the beginning of the course. This will better reflect "real-life" situation than if students formed their own teams which would involve friendship, and other social factors influencing team make-up. The group of five is large enough to provide a diversity of ideas but small enough to promote participation by each student. They will be required to interact and participate in the group decisions, especially for developing a research project.

Students will be primarily second quarter sophomores (completed 60 quarter hours of college course work). Most will have taken 8 qh hours of chemistry, 9 qh of Biology, physical Geology and an introduction to Statistics and probability. Some students will have had additional science course work.

Laboratory activities:

There will be three laboratory exercises (four or five weeks) devoted to refreshing skills in using balances, spectrophotometers and dissolved oxygen meters. The primary purpose of these laboratories is to establish working teams, develop a cooperative spirit and most importantly to develop skills in formulation of methods and understanding sources of variance and simple statistical methods for discerning differences among means.

During the week before the laboratory, students will be given the goals and objective of the laboratory and the materials that are available for the laboratory. Each team will be required to formulate procedures to accomplish the objectives of the laboratory. These team "methods" will then be distributed to all students and, by consensus, a common set of methods will be developed for the laboratory. This procedure will be repeated for each of the first three laboratories.

The data from all groups will be shared and each group will co-author a laboratory report. The laboratory report must be composed using a computer and include computer generated illustrations if appropriate. Also an oral report, one from each group, will be made to the class. The person responsible for presenting the oral report will be preselected by the instructor and rotated in each group to insure that every student has an opportunity to make an oral report to the entire class.

The specific topic or materials used in the laboratory are of secondary importance. Ideally they will be germane to topics in the lecture portion of the course, but not necessarily. The materials included here (soil, nutrient phosphorous and dissolved

oxygen) are all important subjects of the course.

Laboratory 1, materials:

1. Analytical balances, 180g capacity, +/-0.0001g.
2. Gravity drying ovens
3. Muffle combustion furnaces
4. Crucibles, desiccators, forceps, mortar and pestles
5. Fresh top soil (horizon A) samples for each student from a different habitat for each "research group" (five subsamples per habitat, five habitats).

Students will be asked to formulate methods that will determine:

1. moisture content of the soil samples
2. volatile component of the soil samples
3. variability (error) attributed to methods (instrument and technique), and to intrinsic to the material.
4. probability that there are differences in the soil moisture and volatile component attributable to habitat.

Student formulated methods will be expected to include: drying temperature, drying duration, sample size, cooling time, grinding and homogenization, ashing temperature, ashing time, cooling time for ashing. Statistical procedures would include, standard deviation, coefficient of variation and Oneway ANOVA.

A set of suitable literature reports that include methods employed in drying and ashing materials will be provided. Wherever possible, this information will be provided via CD or other computer accessed information sources. Literature (hand-outs, literature and texts on statistical procedures) appropriate for the project will be provided. Computer software to do the statistical analysis will be available (Quattro Pro, Excel, Number Cruncher etc.) Students will all have taken Computer Information Science 520 or 540, where they learn Word perfect, Quattro Pro, DOS, and access to INTERNET.

Laboratory 2, materials.

1. Dissolved oxygen meter
2. Beakers and flasks
4. Small aquaria, one for each team, each aquaria constructed differently:
   a) water + plants
   b) water + plants + animals
   c) water + sediments
   d) water + sediments + plants etc.

Student will be asked to determine the dissolved oxygen content of the water in the aquaria using a DO meter.

The pedagogy for this lab will be the same as for Laboratory 1. Student generated methods will include: calibration, account for

temporal changes and heterogeneity in the dissolved oxygen content in the aquaria. Students will determine sources of error and variability. Literature, handouts, computer accessed data necessary to develop the methods and analyze the data will be provided.

Laboratory 3, spectrophotometry - determination of phosphorous in water. (A two week exercise).

Materials:

1. Spectronic 21, spectrophotometer
2. Appropriate glassware: graduated cylinders, beakers, Erlenmeyer flasks, test tubes etc
3. Repipets for reagents
4. Eppendorfer pipets for samples
5. Membrane filtration apparatus
6. Centrifuge
7. Chemical necessary to determine reactive, dissolved and particulate phosphorus via the molybdate reduction method.
8. The same aquaria set-ups as for exercise 2.

Students will be asked to determine the phosphorous content (total, soluble and reactive) of the water in the aquaria.

The pedagogy for this lab will be the same as for Laboratory 1. Student generated methods will include: standardization, account for temporal changes and heterogeneity in the phosphorous content in the aquaria (information will be supplied to use a modified Standard Methods procedure that uses only 10 ml samples). Students will determine sources of error and variability. Literature, handouts, computer accessed data necessary to develop the methods and analyze the data will be provided.

Laboratory week 5-9.

Student generated experiments. During the first four weeks of the course students will be encouraged to think about specific research problems that they might investigate for their research project.

The project development sequence will be:

1. Discovery and description of an appropriate research project. Students will develop their research problems as a team. the instructor will provide guidance to assure that the projects are tractable in the remaining laboratory time and consistent with available instrumentation and skills of the students. Appropriate problems would include: effects of stressors on oxygen uptake by aquatic animals or sediments; effect of nutrient or stressors on oxygen production of aquatic plants; relationship between sediment volatile component content and oxygen demand etc.
2. Delineation of the problem and presentation of plausible hypotheses. These will be presented orally to the class. After

classmate and instructor input, and if determined to be appropriate by the instructor, the group will develop methods to test one or more of the plausible hypotheses. These will also be presented orally to the class and input from classmates and the instructor will be given.

3. Each group will:
    a) Write a concise procedure for the proposed experiments
    b) Conduct the experiments
    c) Analyzed data
    d) correlate results with existing knowledge
    e) write a formal report
    f) Make an oral presentation of the results to the class

A final comprehensive report that includes the research projects of all the groups will be written and distributed to all students who complete the class. The reports will also be indexed and electronically stored for use by students of subsequent classes.

Literature review:

Data from the Cooperative Institutional Research Program (CIRP) points to the conclusion that interest in science by undergraduate students is declining. Many thousands of qualified students that begin their education as science majors drop out and opt for other majors (Green, 1989). The defection from science is not replaced by recruits from other disciplines resulting in a loss of science majors. This trend has been persistent over the past two decades and threatens the capacity of science and technology to respond adequately to the demands of the near future (Green, 1989). This disaffection from science stems in part from the perception that science is a collection of facts and that science courses are little more than tedious memorization of those facts (Sigma Xi, 1989; Chiappetta, et. al., 1990). Failure to permit science students at all levels to glimpse the excitement of discovery is often cited as the cause for the declining favorable attitude towards science (Sigma Xi, 1989). There have been attempts to change the way in which science is taught to enable students to learn and experience the process of science rather than simply memorize the products of science (Sigma Xi, 1989; Johnson and Johnson, 1987; Cooper 1994). These courses from high school to college have generally met with success. Students achieved higher tests scores when the classes emphasized hands on activities (Chiappetta et. al., 1990, Drake et. al., 1994; Johnson and Johnson, 1987).

Students will be mostly at the mid sophomore level with interests in Environmental Sciences. All students will have taken a computer course in Word Perfect, Quattro Pro, DOS, GBasic and access to INTERNET. All students will have had at least two biology courses, two chemistry courses, a geology and a physics course. Most will also have taken Probability and Statistics.

Student Evaluation:

Students will be evaluated based on the written reports (30%) (collective grades per group), individual oral reports (25%), written examination (25%) and observation by the instructor of individual progress (20%). Grades received in cooperative learning should reflect individual achievement and not the groups achievement (Johnson and Johnson, 1987; Cooper, et. al. 1990). This lessens the perception by conscientious students that their grade may be compromised by the composition of the group (Hixson and Sears, 1994). In order to encourage cooperation rather than competition grades will be based on an absolute scale, i.e. 70%=C, 80%=B, 90%=A.

c. EQUIPMENT

The equipment requested are not unusual for most laboratories in biology and chemistry. All items are specifically involved in one or more of the laboratory exercises.

Single pan analytical balances will be used though out the course for determining mass of materials.

Spectrophotometers will be used to determine phosphorous content of water sample for Laboratory Exercise 2. They also will be available for student use for specific student initiated research projects including colorimetric analysis of other compounds, turbidity and other measurements as determined by the student research teams.

Dissolve oxygen meters will be used for Exercise 3. They also will be available for student use in student team research projects.

Centrifuges are necessary for the determination of phosphorous and will also be available for use by students in their team research projects.

Computers will be used throughout the course as mechanisms for composition, statistics, data management and presentation and as an access to literature and other data.

Criteria for choosing equipment:

1. relatively simple to use, appropriate for sophomore level science students
2. have sufficient precision to imply that the instruments must be used carefully and gently
3. be appropriate for the types of questions raised in the lecture portion of the class
4. be versatile to apply to many types of questions that students may ask

For these reasons, analytical balances (the fundamental instrument of most analytical methods), spectrophotometers, (versatile water chemistry analytical instruments) and dissolved oxygen meters (D.O. is the most useful measurement of water quality, and can be used to monitor metabolic processes) were selected as the most appropriate instruments for the class.

Computers are now fundamental instruments for nearly all classes. The computers requested for this project are

indispensable for achieving the goals and objectives. they will facilitate literature search, data analysis, and report presentation.

The course is organized in units of five students, therefore one instrument is required for every five students in the course. The class will be designed for 30 students thus 6 units of each instrument will be required.

Equipment on hand for the project. This is a new course in a new division of the University. Because the course is new there is a window of opportunity to try a different approach to teaching a science laboratory course. But also because it is new and in a new division of he University there is no existing equipment. However, supplies including glass ware and chemicals will be provided through supportive science departments: Biology, Chemistry and Geology.

Implementation is direct. The instruments will be placed in an existing laboratory that is appropriate for the class. Set-up of the instruments is straight forward and can be accomplished by the instructor or an assistant. The University provides "Electronic Maintenance" technical service which will set-up the computers. Also the University has a contract for general maintenance of balances. All balances are services once each year. The Electronic Maintenance" department also services spectrophotometers.

d. FACULTY EXPERTISE

Dr.Lauren Schroeder is the primary person responsible for the course. He has over 25 years teaching experience at YSU and has been instrumental in establishing several "new" courses, including a team taught course "Humans and the Technological Society". Dr Schroeder along with Drs. Martin and Mincey established a minor program in Environmental Science (the forerunner to the present program). As part of this program they developed two new team taught courses: Water Quality Analysis I and II. They believe that research should be an integral part of undergraduate science education and that research is the essence of science not the factual results of research. Dr. Schroeder has had several research grants, and has always involved undergraduate students in his research projects. Other science faculty including Drs. Martin, Mincey, Dick, and Biersdorffer share this philosophy and are supportive of the project and are willing to participate if needed.

e. DISSEMINATION AND EVALUATION

Evaluation of the project will be based on pre and post tests for improvement in critical thinking, ability to discern and describe problems, skill in experimental design, ability to draw logical conclusion from data.

Example of test questions include:

1. Critique the claim that medicine X is better for relieving headaches than medicine Y because more doctors recommend medicine X.

2. You are standing in a deciduous forest. As you look around what questions come to mind?

3. Chose one of the questions that you stated for question 2 and list several possible answers.

4. Describe an experiment that could be done to test (support or refute) the one of the possible answers given in question 3.

5. A data set from a literature will be presented and the student asked to draw conclusions.

6. Questions that measure understanding and ability to apply the concepts of: variability, precision, and accuracy.

7. Questions that measure understanding of sources of error, and discrimination among means (t Student's t test, Oneway ANOVA etc.

Determination of attitude, types of questions:

____1. On a scale of 1-5 indicate how well you like science.
(1 2 3 4 5)
highest score lowest score

____2. On a scale of 1-5 indicate how this course has affected your attitude toward science.
(1 2 3 4 5)
much more favorable much less favorable

____3. On a scale of 1-5 indicate how this laboratory course compares to other science laboratories that you have taken.
(1 2 3 4 5)
Much better much worse

____4. On a scale of 1-5 indicate how enthusiastically you would recommend this course to a friend.
(1 2 3 4 5)
yes no

A similar attitude questionnaire will be given to comparable students in other laboratory courses: Sophomore level Biology, Chemistry and Geology. Post hoc subjective evaluation of attitudes toward science and the laboratory course by students who have just completed the course would be expected to be favorable. Thus high scores would not necessarily indicate that the course improved students attitudes toward science or towards science education. However a low score relative to scores from traditional science laboratory courses would indicate that the laboratory failed in achieving a more positive perception of science. Other studies have indicated that attitudes and interest levels in science are difficult to change by curriculum changes or instructional techniques (Maoz and Rishpon, 1990) however, if there is no difference in attitude relative to more traditional courses and if other objective are met e.g. improvements in creative thinking, hypothesis formulation, experimental design and communication skills,then the course would be successful.

Another important aspect of higher education is cost effectiveness. How does this proposed approach compare to other methods for achieving the goals of the course? While this cannot be answered in this single class, a careful accounting will be made of the time and effort to produce the course.

If the results are promising then a the approach will be extended to laboratories for non-science majors.

Dissemination of the results will be via publication in an appropriate science education journal. Also the new Center for Environmental Studies is working closely with 10 two year colleges in the northeastern Ohio region. Because of the close relationship among these colleges the progress of the course and results from this course will be shared on a routine basis (members from the colleges meet bimonthly).

The impact of the course initially will be on about 60 students, the anticipated enrollment for winter 1996. However, the enrollment in this course will increase to about 180 per year by 1998. Additionally,if the course results in significant improvements in attitude towards science, or achievement of the goals for the course,then it will be extended in principle to the biology science course for non-science majors (Biology 505). There are more than 1200 students in this course each year. Currently the Biology 505 course does not include a laboratory.

Literature Cited

Chiappetta, E., H.C. Waxman and G. H. Setna. 1990. Student attitudes and perceptions. The Science Teacher, April 52-55.

Cooper, M.M. 1994. Projects Supported by the NSF division of undergraduate education, 307.

Cooper, J., S. Prescott, L. Cook and L. Smith. 1990. Cooperative Learning and College Instruction; California State University Foundation, Long Beach, CA.

Drake, B.D., G. M. Acosta, D. A> Wingard and R.L. Smith, Jr. 1994. Improving creativity, solving problems, and communicating with peers in engineering and science laboratories. Journal of Chemical Education 71: 592-596.

Hixon, S. H. and C.T. Sears, Jr. 1994. Projects supported by the NSF Division of Undergraduate Education. 71:307.

Hofstein, A., N. Maoz, M. Rishpon. 1990. Attitudes towards school science: A comparison of participants and nonparticipants in extracurricular science activities. School Science and Mathematics 90: 13-22.

Johnson, D.W. and R.T. Johnson. 1987. Learning Together and Alone; Cooperative, Competitive, and Individualistic Learning. Holt Reinhardt and Winston. New York, 1987.

Moaz, N. and M. Rishpon. 1990. Attitudes towards school science: A comparison of participants and non-participants in extracurricular activities. School Science and Mathematics. 90: 13-22.

National Science Board, Undergraduate Science , Mathematics and Engineering Education; U.S. Government Printing Office: Washington, D.C. 1986.

Sigma Xi.1989 An Exploration of the Nature and Quality of Undergraduate Education in Science, Mathematics and Engineering. Sigma Xi, The Scientific Research Society, New Haven CT.

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Education:

Saint Cloud State College 1955 - 1959, B.S.
University of South Dakota 1963 - 1964, M.A.
University of South Dakota 1965 - 1968, Ph.D.

Career:

Director, Center for Environmental Studies 1994 -
Professor (Biology) 1977 -

Grants:

National Science Foundation, "Nutrient limitation of tree-leaf feeding insects" 1987 - 1990
National Science Foundation, "Seasonal tracking of leaf quality by Lepidoptera" 1979 - 1981
National Science Foundation Research, "Energy budgets of Lepidoptera feeding on black cherry trees" 1974 - 1976
National Science Foundation Undergraduate Research Grant 1970
Ohio Water Service Company "Comparative limnology of six reservoirs in northeastern Ohio" 1985
Renewed 1986, 1987, 1988, 1989, 1990, 1991
Academic Challenge Program (an award from the Ohio State Board of Regents to YSU, principle author) 1986 - 1992

Publications:

Schroeder, L. 1986. Protein limitation of a tree leaf feeding lepidopteran. Ent. exp. and appl. 41:115-120.

Schroeder, L. 1986. Changes in tree leaf quality and growth performance of lepidopteran larvae. Ecology. 67:1628-1636.

Malmer, M. and L. Schroeder. Amino acid analysis by high performance liquid chromatography with methanesulfonic acid hydrolysis and 9-fluorenylmethylchloroformate derivitaization. J. Chromatography, 514:227-239..

Schroeder, L.A. and Joan Lawson, 1992. Temperature effects on the growth and dry matter budgets of Malacosoma americanum. J. Insect Physiol.

Paper presented:

1992 Kent State University, Population dynamics of Hydra"
1993 Swedish Agricultural University, Uppsala Sweden, "Protein limitation of lepidopteran larvae".
1993 Swedish Agricultural University, Uppsala, Sweden, "Metabolic models for nutrient utilization".
1993 The Ohio Alliance for the Environment, "Job opportunities in environmental specialties"
1993 The Ohio Environmental Protection Agency, Polycyclic aromatic hydrocarbons and bullhead populations in the Mahoning River".

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EDUCATION

Ph.D. Applied Geology (1992) Kent State University
Dissertation: "Relationships Between Durability and Lithologic Characteristics of Mudrocks"
M.S. Geology (1982) Kent State University
Thesis: "Evaluation of the Groundwater Resources of Kirtland, Ohio and Adjacent Areas"
B.S. Geology (1980) Kent State University

PUBLICATIONS

Dick, J.C. and Shakoor, A., 1990, The Effects of Lithologic Characteristics on Mudrock Durability: Proceedings of the 6th International Congress of the International Association of Engineering Geology, Amsterdam, The Netherlands, Vol. 4, pgs. 3061-66.

Dick, J.C. and Shakoor, A., 1991, A Mudrock Durability Classification System Based on Lithologic Characteristics: Proceedings of the 34th Annual Meeting of the Association of Engineering Geologists, Chicago, Illinois, pgs. 189-196.

Dick, J.C. and Shakoor, A., 1992, Lithologic Controls of Mudrock Durability: Quarterly Journal of Engineering Geology, London, Vol. 25, pgs. 31-46.

Dick, J.C., Shakoor, A., and Wells, N.A., 1994, A Geological Approach Toward Developing A Mudrock Durability Classification System: Canadian Geotechnical Journal, Vol. 31, No. 1, pgs. 17-27

Dick, J.C. and Shakoor, A., Characterizing Durability of Mudrocks for Slope Stability Purposes: Reviews in Engineering Geology: Clay and Shale Slope Instability, Geological Society of America, Invited manuscript submitted June 15, 1993, Accepted for publication September 9, 1993.

GRANTS AND AWARDS

National Science Foundation, 1993, ILI Support for academic project: "Subsurface Investigations: An Integration of Geological Principles" Grant No. DUE-9351871, Grant Amount $23,215

Kent State University Outstanding Ph.D. Student Award, 1991
Amoco Alumni Scholarship 1989 and 1990
Kent State University Graduate Research Scholarship, 1989
Kent State University Fellowship Award, 1989
Sigma Xi Grants-in-Aid of Research Award, 1989

DARYL W. MINCEY

Positions: Professor, Department of Chemistry and
Assistant to the Dean, College of Arts and Sciences
Address: Youngstown State University, Youngstown, OH 44555.

Education: Ph.D. University of Cincinnati, Analytical (Bio)Chemistry (1978)
M.S. University of Cincinnati, Analytical Chemistry (1974)
B.S. University of Cincinnati, Chemistry (1972)

Expertise: Analytical instrumentation; environmental analysis.

Honors and Awards:

Youngstown State University - Distinguished Professor Award, 1988
Youngstown State University - Research Professor, 1983-84
Youngstown State University - Sabbatical Leave, 1989-90

Selected Publications:

Daryl W. Mincey, Marc J. Popovich, Patrick J. Faustino, Marilyn, M. Hurst, and Joseph A. Caruso, 1990. Monitoring of ElectroChemical Reactions by Nuclear Magnetic Resonance Spectrometry. *Analytical Chemistry*, **62**:1197-1200.

Daryl W. Mincey, Kenneth J. Kuzior, Leslie H. Allen III, Jennine S. Frease and Irene N. Strasser, 1991. A Microprocessor Regulated Constant Voltage, Current, Wattage and Temperature Electrophoresis Power Supply, *Analytical Biochemistry*, **193**:168-172.

Jeffrey J. Giglio, Daryl W. Mincey, and James H. Mike, 1991. The Analysis of Steel Samples Employing Ion Chromatography/Sequential Inductively Coupled Plasma Atomic Emission Spectroscopy, *Analytica Chemica Acta*, **254**:109-112.

Daryl W. Mincey, Richard C. Williams, Jeffrey J. Giglio, Gale A. Graves, and Anthony J. Pacella, 1992. Temperature Controlled Microwave Oven Digestion System, *Analytica Chemica Acta* **264**:97-100.

Other Collaborators (last 48 months): S.C. Martin, L.A. Schroeder, W.C. Dyer, L. Lyden, R.J. Dulberger

Graduate Advisor: Joseph Caruso

Graduate Advisees: Michael T. Bell; Gary Louis Boano; Evanthia N. Diaconis; David C. Jirinzu; Caroline R. DeVincent; Patrick J. Faustino; Gale A. Graves; Wesley A. Gray; Bruce R. Hahn; Charles F. Kovach; Donald M. Sebest; Lawrence P. Gurlea; Jennine Marie Snier-Frease; Irene Nicole Straser; Roseann Baca; Kenneth J. Kuzior; Paul Shiller; Janet Einfalt; Maria K. Ferguson; Darla Gault Little; Richard Clair Williams

SCOTT C. MARTIN

Position: Professor, Department of Civil & Environmental Engineering
Address: Youngstown State University, Youngstown, OH 44555.

Education:
Ph.D.: Clarkson University, Civil & Environmental Engineering (1984)
M.S.: Clarkson University, Civil & Environmental Engineering (1979)
B.S.: Clarkson University, Civil & Environmental Engineering (1977)

Expertise: Nutrient dynamics; eutrophication; water quality modeling; applications of GIS and GPS; pollutant-sediment interactions; aquatic chemistry; constructed wetlands.

Honors and Awards:

International Association for Great Lakes Research - Chandler-Meisener Award (1982)
Youngstown State University - Distinguished Professor Award (1988 and 1994)
Youngstown State University - Sabbatical Leave (1991-92)

Selected Publications:

Martin, S.C., R.J. Ciotola, P. Malla, N.G.S. Urs, and P.B. Kotwal, 1994. Assessment of Sediment Phosphorus Distribution and Long-Term Recycling in St. Albans Bay, Lake Champlain. Lake Champlain Basin Program Tech. Rep. No. 7c. Prepared for Lake Champlain Management Conference, Grand Isle, VT, 202 pp.

Martin, S.C., S.C. Hinz, P.W. Rodgers, V.J. Bierman, Jr., J.V. DePinto, and T.C. Young, 1994. Calibration of a Hydraulic Transport Model for Green Bay, Lake Michigan. Submitted for publication to *Journal of Great Lakes Research*.

Bierman, V.J., J.V. DePinto, T.C. Young, P.W. Rodgers, S.C. Martin, and R. Raghunathan, 1992. Development and Validation of an Integrated Exposure Model for Toxic Chemicals in Green Bay, Lake Michigan. Final Report for Cooperative Agreement CR-814855, ERL-Duluth, Large Lakes and Rivers Research Branch, Grosse Ile, MI, 48138, 350 pp. (September, 1992).

Martin. S.C., S.W. Effler, J.V. DePinto, F.B. Trama, P.W. Rodgers, J.S. Dobi, and M.C. Wodka, 1985. Dissolved Oxygen Model for a Dynamic Reservoir. *Journal of Environmental Engineering*, **111**(5):647-664.

Martin, S.C., J.V. DePinto, and T.C. Young, 1984. Biological Availability of Sediment Phosphorus Inputs to the Lower Great Lakes. USEPA Environmental Research Lab, Duluth, MN. EPA-600-03-84-100.

Other Collaborators (last 48 months): L.A. Schroeder, D.W. Mincey, X. Zhang; I.A. Khan; T.A.D. Slawecki; W.C. Dyer; R.J. Dulberger; L. Lyden, J. Alam

Graduate Advisors: J.V. DePinto; J.K. Edzwald

Graduate Advisees: J.S. Evan; B.A. Abbas; W.M. Mohammad; P.B. Kotwal; W. Kirubakaran;

ILI-IP DETAILED BUDGET (EQUIPMENT LIST) FORMAT

Item (Descriptive name, probable brand and model)	How Many	Unit Price (List)	Unit Price (Discounted)	Total Cost (Discounted)
Single pan analytical balance, Metler, AG204	6	3,095	2,631	15,785
Gravity drying ovens, Precision Model 45EM	6	1,395	1,186	7,114
Spectrophotometers, Milton Roy Spectronic 21DV	6	2,975	2,529	15,173
Dissolved Oxygen Meters, Orion Model 840 /w replacement parts	6	1,750	1,488	8,925
Muffle furnace, Thermolyne, Type 6000, Automatic	6	2,885	2,452	14,713
Centrifuge, HN-SII, IEC Model 2355 w/rotors & buckets	6	2,920	2,482	14,892
Computers,Gateway 2000 P5-90XL 16 MB RAM, MS-DOS 6.22, Windows WP 6.0, Excell	6	3,660	3,660	21,960

Total project cost:	$98,600
Non-NSF contribution (including any overmatch):	49,300
NSF request:	49,300

Use additional pages(s) if needed.

Current and Pending Support

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: Schroeder

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

Support: [X] Current [ ] Pending [ ] Submission Planned in Near Future [ ] *Transfer of Support

Project/Proposal Title: "Development of an Environmental Studies Program"

Source of Support: Ohio EPA

Award Amount (or Annual Rate): $ 49,000.00 Period Covered: June 1993 - June 1995

Location of Project: Youngstown State University

Person-Months Committed to the Project. Cal: 1 Acad: Summ:

Support: [X] Current [ ] Pending [ ] Submission Planned in Near Future [ ] *Transfer of Support

Project/Proposal Title: "Limnological Studies of Ohio Water Service Lakes"

Source of Support: Ohio Water Service Co.

Award Amount (or Annual Rate): $ 5,000.00 Period Covered: 1994 - 1995

Location of Project: Youngstown State University

Person-Months Committed to the Project. Cal: 1 Acad: Summ:

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

Project/Proposal Title:

Source of Support:

Award Amount (or Annual Rate): $ Period Covered:

Location of Project:

Person-Months Committed to the Project. Cal: Acad: Summ:

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

Project/Proposal Title:

Source of Support:

Award Amount (or Annual Rate): $ Period Covered:

Location of Project:

Person-Months Committed to the Project. Cal: Acad: Summ:

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

Project/Proposal Title:

Source of Support:

Award Amount (or Annual Rate): $ Period Covered:

Location of Project:

Person-Months Committed to the Project. Cal: Acad: Summ:

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

Current and Pending Support

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: Dick	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: "Subsurface Investigations: An Integration of Geological Principles"

Source of Support: NSF
Award Amount (or Annual Rate): $ 23,215.00 Period Covered: August 1, 1993 - January 31, 1996
Location of Project: Youngstown State University
Person-Months Committed to the Project. Cal: 1 Acad: Summ:

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

Source of Support:
Award Amount (or Annual Rate): $ Period Covered:
Location of Project:
Person-Months Committed to the Project. Cal: Acad: Summ:

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

Source of Support:
Award Amount (or Annual Rate): $ Period Covered:
Location of Project:
Person-Months Committed to the Project. Cal: Acad: Summ:

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

Source of Support:
Award Amount (or Annual Rate): $ Period Covered:
Location of Project:
Person-Months Committed to the Project. Cal: Acad: Summ:

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

Source of Support:
Award Amount (or Annual Rate): $ Period Covered:
Location of Project:
Person-Months Committed to the Project. Cal: Acad: Summ:

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

Current and Pending Support

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: Mincey

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: "Introduction to Bio-Separation: An Undergraduate Laboratory"

Source of Support: NSF
Award Amount (or Annual Rate): $ 50,000.00 Period Covered: 1995 - 1996
Location of Project: Youngstown State University
Person-Months Committed to the Project. Cal: 1 Acad: Summ:

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

Source of Support:
Award Amount (or Annual Rate): $ Period Covered:
Location of Project:
Person-Months Committed to the Project. Cal: Acad: Summ:

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

Source of Support:
Award Amount (or Annual Rate): $ Period Covered:
Location of Project:
Person-Months Committed to the Project. Cal: Acad: Summ:

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

Source of Support:
Award Amount (or Annual Rate): $ Period Covered:
Location of Project:
Person-Months Committed to the Project. Cal: Acad: Summ:

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

Source of Support:
Award Amount (or Annual Rate): $ Period Covered:
Location of Project:
Person-Months Committed to the Project. Cal: Acad: Summ:

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

Current and Pending Support

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: Martin

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: "Removal Mechanisms for Heavy Metals in Constructed Wetlands"

Source of Support: University Research Council

Award Amount (or Annual Rate): $ 300.00 Period Covered: October 15, 1994 - June 15, 1995

Location of Project: Youngstown State University

Person-Months Committed to the Project. Cal: 0 Acad: Summ:

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

Project/Proposal Title:

Source of Support:

Award Amount (or Annual Rate): $ Period Covered:

Location of Project:

Person-Months Committed to the Project. Cal: Acad: Summ:

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

Project/Proposal Title:

Source of Support:

Award Amount (or Annual Rate): $ Period Covered:

Location of Project:

Person-Months Committed to the Project. Cal: Acad: Summ:

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

Project/Proposal Title:

Source of Support:

Award Amount (or Annual Rate): $ Period Covered:

Location of Project:

Person-Months Committed to the Project. Cal: Acad: Summ:

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

Project/Proposal Title:

Source of Support:

Award Amount (or Annual Rate): $ Period Covered:

Location of Project:

Person-Months Committed to the Project. Cal: Acad: Summ:

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

Appendix a (no entry)

Appendix b

Course Descriptions: Fundamental of Environmental Studies, ENST 601. A team taught survey course of fundamental issues in environmental studies including biodiversity, global warming, acid precipitation, toxins, energy production, etcc. ENST 601 is required of all Environmental Studies Majors. Prereq.: BIOL 509, or CHEM 506, or GEOL 505.

ENST 601L. Fundamental of Environmental Studies Laboratory. A laboratory investigating problems identified by ENST 601. The course will emphasis problem solving techniques, data analysis and report writing. The class meets three hours per week. Concurrent with ESNT 601.

The course will be offered for the first time during the Winter quarter of 1996. The first class will have 60 students. It will be subsequently offered every quarter. The total anual enrollment will be 180 students.

Appendix c.

Subject area majors.

The program in Environmental Studies is new to Youngstown State University. The Program received approval by the Ohio Board of Regents on October 17, 1994. Student interest in the program is high. Already (November 10, 1994) there are 65 students who have either enrolled in the program for Winter Quarter or have completed the preliminary procedures for enrolling in the Program. We expect that it will be necessary to cap enrollment. Therefore the student enrollment projections are realistic.

About 50 % of the current students intending to enroll in Environmental Studies are opting for the Science Track. Most of these students will continue to graduate school. Our estimation is that about 40 students from each years enrollment (180 students) will attend graduate school.