PCB LECTURE FOR AN INTRODUCTORY CHEMISTRY COURSE

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Overview: Dr. Martino created a lecture on the chemical and toxic properties of PCBs and co-authored an NSF proposal to upgrade the teaching skills and research knowledge of 2-year college faculty.

Introduction

The year since the Great Lakes Research Consortium’s Ecosystem Dynamics practicum was a very busy one, including changing jobs to another UW Center, moving the household, and the arrival of a baby. My major practicum-related activity was researching and writing a lecture on PCBs for an introductory chemistry course (Appendix 1). That course will be taught in the fall of 1993. Now that my professional life is settled for awhile, as time goes on, I hope to incorporate more practicum materials into the courses I will teach.

Grant Proposal

Discussions at the practicum about grant possibilities to support undergraduate teaching stimulated Janice Alexander (another 1992 participant) and me to co-write a proposal (Appendix 2) to NSF titled: “Improving Science Education in the UW Centers: Workshops for Science Faculty”. The proposal seeks to establish a coalition between the University of Wisconsin Centers, a 2-year institution comprised of 13 campuses, and two 4-year institutions: IJW-Eau Claire and UW-Green Bay. The primary objective of the coalition is to help the two-year faculty learn about advances in their disciplines and to help them incorporate these developments into their classes. Coalition activities will include summer workshops and follow-up activities during the academic year. Workshops will be multi-disciplinary, including biology, chemistry, physics, geology and engineering. The Coalition also will bring 2- and 4-year faculty together for cooperative research.
Appendix 1

An Introductory Chemistry Lecture: Polychlorinated Biphenyls

Polychlorinated biphenyls (PCBs) are now an infamous group of chemicals which once had widespread applications for a period of 27 years. PCBs were first prepared commercially in 1929 and were produced until their ban in 1976 by the Substance Control Act. PCBs were mainly used as fire retardants in oils. Their main use was as an additive to electrical transformer oil which lowered the risk of transformer fires.

Why were PCBs used as a fire retardant?

There are several reasons:

1. Production was simple and inexpensive.
2. Like oils, most PCBs are liquids or low-melting solids and can easily be mixed with oils.
3. Like oils, PCBs are hydrophobic or “water—hating” compounds and to quote an old chemical proverb, “Like dissolves like”, so PCBs dissolve readily in oil.
4. PCB’s have very low potential energies of reaction. As indicated by the diagram below, the conversion of PCBs into products requires a large amount of activation energy (when a catalyst is not present). In other words, it takes a lot of work for each PCB molecule to make it “over the hill”.

![Diagram of energy levels](image)

* Transition State

PE = Potential Energy

This is why PCBs are great flame retardants. PCBs require a large amount of thermal energy prior to undergoing all reactions including combustion reactions or burning PCBs.

Unfortunately, several of the reasons for the infamy ascribed to PCBs are identical to the desired chemical properties for fire retardant application that were previously discussed.

PCBs are troublesome because:

1. An estimated 1.2 billion pounds were produced over a 47 year period because production was cheap and feasible.
2. Most PCBs are liquids or low melting solids which has lead to nearly ubiquitous contamination via both water and airborne travel.
3. PCBs are hydrophobic or “water—hating” compounds and accumulate in the hydrophobic molecules of living organisms (mainly fats, and oils).
4. The activation energy for the conversion of PCBs into harmless product compounds is high. What this means is that the rate of destruction of PCBs is very slow without the use of a catalyst which would lower activation energy. Simply stated, the “hill” has to be lowered to speed up the reaction.
5. PCBs contaminate the food chain and are found in higher concentrations in animals further up the food chain. It is reasonable to assume that humans are contaminated with high levels of PCBs.

As mentioned above, PCBs are ubiquitous in high concentrations, they accumulate in oils and fats of living matter (including humans), and they take a long time to degrade. This alone does not account for PCBs infamy.

Several studies on toxicity of PCBs have been documented. Most studies have been accomplished using animals as subjects. A few accidental major poisoning catastrophes have led to data on humans. The Environmental Protection Agency (EPA) has accomplished a review of the studies that are in press. The EPA has come to the conclusion that humans may be susceptible to PCB carcinogenic effect (mainly liver cancer).

Several studies indicate that expectant mothers who are contaminated with PCBs have an increased risk of having birth defective children.

Other studies have suggested that PCBs are neurotoxic because they alter behavior. Helen Daly et al., have reached the conclusion that rats fed Great Lakes salmon show greater aversiveness to unpredictable non-reward than normally fed rats. In other words, rats feasting on PCBs-laden fish are “stressed-out”.

Currently, much chemical research is underway to understand the degradation of PCBs. Most studies are aimed at finding a catalyst to degrade PCBs at a faster pace. These studies involve the following:

1. Determination of a reaction mechanism for degradation of PCBs. This is of interest because if the mechanism is understood a catalyst can be designed to speed up the rate limiting step. This would involve lowering the activation energy for the formation of the transition-state that is of highest potential energy. To do this one needs to know the structure of this transition—state. Then one can hypothesize how to make the transition state at a lower energy cost. One possibility would be to produce a catalytic antibody which would act as an enzyme that degrades PCBs. The antibody-enzyme would act as a “mold” to hold the PCBs into the shape of the transition state. The enzyme would pay some of the energy cost.

2. Isolation of bacteria that degrade PCBs. This is of interest because if one can isolate a “bug” that “eats” PCBs, one can simply grow this “bug” in a landfill of PCBs. Alternatively, one can isolate the enzyme responsible for PCBs degradation from the “bug”. Then one can use the tools of molecular biology to clone the enzyme and produce the enzyme in super high concentrations which can be used to treat contaminated landfills.

It is an understatement to say that PCBs contamination is important to scientists. PCBs contamination is important to everyone. Please, educate friends and parents about this topic covered today, since it is of vital importance to society. Not only because it is a topic that affects us all (we are all contaminated), for we need to prevent similar problems from reoccurring. In hind sight, it is simple to see why PCBs should have been understood by the public prior to their release into the environment. The chemical properties of PCBs should have given society clues towards their potential hazards.

If it does not burn it probably decomposes slowly.

If it likes to dissolve in oils, it probably will dissolve in human fats and oils.

If it is a liquid at average temperatures it can contaminate via water transport.

If it is a solid at average temperatures it can contaminate via airborne transport.
Appendix 3

IMPROVING SCIENCE EDUCATION IN THE UW CENTERS: WORKSHOPS FOR SCIENCE FACULTY

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IMPROVING SCIENCE EDUCATION IN THE UW CENTERS: WORKSHOPS FOR SCIENCE FACULTY

NARRATIVE

I. INTRODUCTION

This proposal seeks to establish a coalition between the University of Wisconsin Centers, which is a two—year institution, and two four—year institutions: the University of Wisconsin—Eau Claire and the University of Wisconsin—Green Bay. The primary objective of the Coalition is to help the two—year faculty learn of new advances in their disciplines, and to help them plan ways to incorporate these developments into their classes. Coalition activities will include summer workshops and follow—up activities during the academic year. The Coalition will also bring together the two— and four—year faculty in on—going collaborative research.

The Context: a Two-Year College with Small; Widely-Dispersed Campuses. The University of Wisconsin Centers (UWC) is a public, multi—campus, two—year institution which offers freshman— and sophomore—level liberal arts courses to approximately 11,000 students yearly (see brochure Appendix A). The UWC has thirteen campuses located in small and medium size cities throughout the state, and a central office in Madison (see map Appendix B). The thirteen UWC campuses range in size of enrollment from UW Center—Richland, with 436 students, to UW Center—Waukesha County, with 2136. The UWC's academic departments are organized as they would be if the institution were single—sited, i.e. in each discipline there is a single department whose faculty members teach on different campuses. All thirteen campuses offer courses from a common curriculum. The UWC is one of fifteen institutions of the University of Wisconsin System, which is responsible for all public higher education in the State.

The Problem: Scientific and Professional Isolation. Like good science teachers everywhere, the UWC science faculty wish to convey the latest developments in science to their students, and wish to give their students a sense of the excitement of science as a dynamic, ever—growing body of knowledge. But several obstacles make it difficult for the faculty to stay abreast of current developments in their field, and to maintain a sense of enthusiasm about incorporating new developments into their teaching. First, full—time science faculty at the UWC typically carry a 12—credit teaching responsibility. Second, laboratory facilities are so modest that faculty cannot realistically conduct research in them. Third, and perhaps most important, is the professional isolation which UWC science faculty experience as a result of the institution’s size, geography, history, and budget. Faculty experience disciplinary isolation because they work at relatively small, widely—dispersed campuses. Individual faculty often constitute a “department—of—one” on their campus, and have few opportunities for interaction with their peers on the other UWC campuses. The once— or twice—yearly departmental meetings are often the only time faculty meet with their departmental colleagues. Constraints of both time and budget make it difficult for UWC faculty to attend national or regional conferences. UWC science faculty also have traditionally been isolated from the science faculty at the other UW System institutions. There currently is no mechanism to help UWC faculty establish working relationships with faculty on the baccalaureate or doctoral campuses. Newly hired faculty typically maintain ties with their thesis advisor, and perhaps with colleagues where they did post—doctoral work. But after a number of years, these ties become weak, and faculty members find themselves scientifically and professionally alone.

The Solution: Forging an Alliance with the State’s Baccalaureate Campuses. In an attempt to find a solution to these problems, the UWC science faculty have been talking with each other and with the science faculty at other UW System institutions. In these discussions it was agreed that more interaction and collaboration between science faculty at the UWC and on the other UW
System campuses would be helpful to all parties. The UWC faculty would benefit by exposure to faculty who are actively engaged in research. Faculty on the baccalaureate campuses would benefit from the experience that UWC faculty have in teaching exclusively freshmen and sophomores.

These discussions have led to a decision to establish a Wisconsin Coalition for the Improvement of Freshman and Sophomore Science Education. Initial members of the Coalition are the UWC, the University of Wisconsin—Eau Claire, and the University of Wisconsin—Green Bay. Other UW System campuses have expressed an interest in joining the Coalition, and could be incorporated in the future. The primary goal of the Coalition is to provide professional development opportunities for UWC faculty members. The Coalition will sponsor summer workshops and follow-up activities during the academic year. The purpose of these activities will be to bring UWC science faculty up to date on developments in their fields, and to discuss the best way to incorporate these developments into the teaching of freshmen and sophomores. Presenters will be teams of faculty from the baccalaureate campuses and the UWC. The Coalition will also serve as a clearing-house for information which will enable UWC faculty to establish working relationships with research-active faculty on the participating baccalaureate campuses. This is seen as a way to counter professional isolation for the UWC faculty.

II. PRELIMINARY WORK

Initial Discussions. In the summer of 1992, three UWC science faculty members (Janice Alexander, Assistant Professor of Chemistry; Catherine Helgeland, Assistant Professor of Geology; and Paul Martino, Assistant Professor of Chemistry) were chosen to participate in a three week workshop funded by the National Science Foundation Undergraduate Faculty Enhancement program, and sponsored by the Great Lakes Research Consortium at SUNY—Oswego, New York. The workshop focused on environmental problem solving as an effective teaching strategy to stimulate undergraduates interest in environmental science. The three found the workshop to be intellectually and scientifically exciting, and they returned with many ideas about how to introduce new material into their classes. At their departmental meetings that August, they shared some of what they learned with their colleagues, who were favorably impressed with the value of the workshop. When they sought other such professional development activities, they discovered that there are a few summer programs in the state, but they are not geared to the needs of two—year college faculty. In view of the great resources that are available in higher education in the State of Wisconsin, the UWC science faculty decided to forge some sort of alliance with the science faculty on the four—year campuses, and create professional development activities out of that alliance. The faculty became aware of the NSF—UFE Coalitions program, and decided to look there for funding for the pilot phase.

The Fall Conference. In response to these faculty concerns, UWC Chancellor Lee Grugel convened a conference on September 18, to begin planning for a science coalition (see conference program, Appendix C). Speakers included Katharine Lyall, the President of the UW System, Dr. Elizabeth Teles of the National Science Foundation, and Dr. Earl Peace, Senior Academic Planner for the UW System. Participants included 24 science faculty from the UWC and 24 faculty from 8 other UW System institutions. The participants showed a great deal of enthusiasm for the idea of forming a coalition, and most responded to a questionnaire about what workshops they would be interested in presenting or attending. With the questionnaire results in hand, Janice Alexander and Paul Martino initiated a series of conference calls with science faculty at several of the four-year campuses, to narrow down the potential workshop topics and participants.

The Spring Survey. Early in March, Alexander and Martino sent a survey to all UWC faculty members in biology, chemistry, geology, and engineering (n=61), asking their level of interest in
several possible workshop topics (see survey Appendix D). The results indicated that there was
strong interest in two topics: environmental science and teaching methods. The decision was
made to offer an environmental science workshop at the University of Wisconsin-Green Bay, in
the northeast part of the state, and a teaching methods workshop at the University of
Wisconsin—Eau Claire, in the northwest part of the state. This decision was based primarily on
the specific strengths of the two institutions. It was also based on geography such that most
UWC faculty members are close to a site.

Descriptions of Participating Institutions.

The mission of the University of Wisconsin Centers is to provide students with the
courses they need to transfer to a baccalaureate institution. (There are no vocational or technical
courses offered; the state has a separate system for vocational—technical education.) The UWC
grants the Associate of Arts and Science degree, which is accepted by all University of
Wisconsin institutions as fulfilling the university—wide, college, and school general education
breadth requirements. In the physical and natural sciences, courses are offered in biology,
botany, chemistry, computer science, engineering, geology, physics, physiology, and zoology.
Course articulation agreements are maintained with all the other campuses in the UW System.

With the least restrictive admissions requirements and the lowest tuition of any UW System
institution, the UWC provides a window of opportunity for many people around the state who
would otherwise find it difficult or impossible to begin their postsecondary education.
Approximately 65% of UWC students are “first generation” college students, meaning their
parents did not attend college. About one third of UWC students are age 25 or older. Fifty-five
percent are female and 4% are minority.

The UWC combines access with high quality academic programming. The two- year retention
rate for the fall cohort of 1987 was 48.1%, a rate which compares favorably with figures
reported by Vincent Tinto, who finds that only 27 percent of all those who enter a two-year
institution are retained for two years. UWC students do well after transfer. Among all those who
began at the UWC as new freshmen in the Fall of 1980, 31.7% had received a bachelor’s degree
by spring 1990. Among those who transferred to a four-year UW institution, 69.8 percent had
received a bachelor’s degree by the spring of 1990. These figures probably underestimate the
true number of bachelor’s degrees, as we are unable to gather data on students who leave the
UWC and enroll at either a technical college or a four— year college other than the campuses in
the University of Wisconsin System.

1 Clare Stapleton Concord and Jennifer B. Presley, “Outcomes of New Freshman
Students: Retention, Graduation and Time to Degree,” Occasional Research Brief 91/2
(Madison: University of Wisconsin System Office of Policy Analysis and Research, March

2 Vincent Tinto, “The Principles of Effective Retention,” transcript of presentation
delivered at the University of Wisconsin Centers Conference on College Student Retention

3 Concord and Presley, op. cit. “Outcomes of New Freshman Students.”

4 Ibid.

Over 85 percent of our instructional positions are held by regular faculty; there arc no teaching
assistants. Temporary or part—time staff account for less than 15 percent of instruction, well
below the Carnegie Foundation recommendation of 20 percent. Among the tenured or tenure-
track science faculty, most hold the terminal degree in their discipline. In biology, 23 of the 29
faculty members have a doctorate; the figures for chemistry arc 13 of 21, for physics 8 of 13, for
geology 2 of 4, for engineering 3 of 3. The science faculty are heavily “tenured—in”: in biology 26 of the 29 faculty members are tenured; in chemistry the numbers are 17 of 21, in physics 11 of 13, in geology 2 of 4, and in engineering 2 of 3. Although the science faculty have not been grant—active in the past, there are signs that is changing: in the past five years we have had a National Science Foundation research grant in mathematics, and five NSF Instrumentation and Laboratory Improvement grants.

The University of Wisconsin—Eau Claire enrolls approximately 10,500 students, including over 500 graduate students, who are serviced by a faculty and staff numbering over 700. The UW-EC offers science course work through the Master’s degree in biology, communicative disorders, environmental and public health, and medical technology. The Graduate Faculty consists of over 300 faculty and academic staff who hold doctoral or appropriate terminal degrees, and who possess a broad array of special qualifications and backgrounds in their academic specialties.

The UW-EC has particular strength in recruiting and retaining students in chemistry. Currently, 154 students are majoring in chemistry or a chemistry—related field at UW-EC; 40% of these students are female. These figures compare very favorably with those of chemistry departments at many much larger universities. The UW-EC chemistry program is a case study in Sheila Tobias’ new book “Revitalizing Undergraduate Science: Why Some Things Work and Most Things Don’t.”5 “The department’s ability to attract first—generation college students is impressive, particularly in the face of statistical evidence that shows that even scientists’ children eschew science,” Tobias writes. Since the first chemistry degree was earned at UW-EC in 1957, more than 500 students have completed the traditional chemistry major. Acting department chairman Robert Eierman says approximately 40% have gone on to earn advanced degrees, and the university ranks among the nation’s top five public undergraduate institutions for the production of chemistry grads who have earned Ph.Ds, with 96.

The University of Wisconsin-Green Bay enrolls approximately 5,000 undergraduate students and 230 graduate students yearly, and offers the Bachelor of Science and Master of Science degrees. Ninety-five percent of the faculty hold the terminal degree in their discipline. At its inception, UW-GB was designated as one of two “special mission” campuses within the UW System. Among several distinguishing objectives, the University was directed to “…offer programs employing a problem—focused approach, including an emphasis on regional, national and global environmental issues, and encourage innovative teaching in support of that approach.” In its efforts to reach this objective, the university developed an innovative major and minor in Environmental Science. This interdisciplinary, problem—focused program is unique in Wisconsin and has successfully combined instruction and research in its efforts to prepare students for productive careers in science.

Course work in the Environmental Science program emphasizes scientific principles which govern natural processes and which underlie the nature of environmental change. Students who major in Environmental Science select one of two emphasis areas: Ecology and Biological Resources Management or Physical Resource Management. Ecological concepts are the basis of much of the course work in the Ecology and Biological Resource Management emphasis area. These concepts provide the means for developing an integrated approach to resource management, an approach which is increasingly recognized as the direction of the future. The focus of the Physical Resources Management emphasis area is the conservation and environmental quality of our physical resources: air, water, and soils. This emphasis area is

5 Research Corporation, Tucson, AZ, 1992
especially appropriate for those who are interested in waste management and the recycling of society’s waste materials.

The Environmental Science program has always made concerted efforts to tie its educational programming and research efforts to the needs of the community and the region and to involve undergraduate students in research activities. In the sciences, student participation in research comprises one of the most important and effective means of learning. At UW-GB, the Environmental Science program has consistently provided numerous opportunities for its students to learn through participation in cooperative research projects with faculty members.

The UW-GB is well situated to be a leader in environmental education and research. The Green Bay area has a large and stable industrial base, consisting largely of pulp and paper industries, power generation, and food processing. Northeastern Wisconsin has the largest concentration of paper industries in the world. There is a natural fit between these industries and UW-GB’s focus on environmental education and research. Waste management and resource recovery are significant concerns in a state which already recycles 1.3 million tons of waste paper annually. As part of Lake Michigan, the bay of Green Bay is the largest freshwater estuary in North America and is heavily impacted by the residuals from these industries as well as non-point pollution sources. UW-GB’s Environmental Science Program provides students with unique educational and research experiences that offer multiple perspectives on the major environmental issues facing the region and the world.

All three institutions are accredited by the North Central Association of Colleges and Schools. It should also be pointed out that the UW System, of which these three institutions are a part, is very active in science education. Just one example is the UW System Women’s Studies Consortium, which is currently administering a five—semester, National Science Foundation—funded program called “Women and Science.” The goal is to address the under—representation of women and minorities in science and engineering. The program seeks to reach students who, though qualified to do science, choose another major. There are many other examples of innovation in science education within the UW System.

III. PROJECT DESCRIPTION

A. Coalition Activities

The Coalition will sponsor two summer workshops and follow—up activities during the academic year, as described below. All Coalition activities are designed to meet the following objectives: 1) to expose the faculty participants to new material in their disciplines; 2) to expose the faculty participants to innovations in science education; and 3) to help the two—and four—year college faculty make connections with each other - connections which will lead to collaborative research or other professional undertakings.

1. Summer Workshops

   We plan to hold two week—long workshops, one on Teaching College Science at the UW—Eau Claire, and one on Environmental Science at the UW—Green Bay. Both will be inter—disciplinary, including material relevant to faculty in biology, chemistry, geology, and engineering. The workshop on Teaching College Science will also include material relevant to faculty in Physics, and will include discipline—specific break—out sessions. The workshops will be team—taught; at each one, the presenters will be from at least two disciplines and from the two campuses involved. The workshops will be very interactive; we believe that the participants have much to share with and learn from each other.

   Selection of Participants. After the notice of grant award from NSF, the Project Director will
publicize the grant and the participation opportunities available. An article will be placed in the campus publication most widely read by faculty (*CenterScope* for the UW Centers, *The University Bulletin* for the UW—Eau Claire, and *The Log* for the UW—Green Bay). A flyer announcing the grant will be placed on the “grants bulletin board” of each campus. A special notice will be sent to department chairs, who will be asked to circulate the information to their faculty members, and encourage them to apply. Chairs will be asked to particularly target and encourage faculty who have not recently been professionally active. At the UW Centers, each eligible person in a relevant department will be sent an individual notice. (We have learned that communication across thirteen campuses is difficult, and requires this personal touch.)

Final selection of participants will be made by two committees, one for each workshop. The committees will consist of the Project Director and the workshop leaders. Participants will be chosen from faculty on the thirteen two—year campuses, and the two baccalaureate campuses. Thus the participants should span the length and breadth of the State of Wisconsin. We plan to include both two— and four—year faculty because one important goal of the project is to get the two— and four—year faculty involved in collaborative research activities. There will not necessarily be equal numbers of participants from the two institutions; every effort will be made to accommodate UW Centers faculty, who are the primary target of this proposal.

The intended audience for the project are those faculty who wish to improve the way they teach science to freshmen and sophomores. Participants will be asked to write a brief (no more than one page) essay describing their background and why they are interested in pursuing the workshop topic. The selection committees will attempt to select those who have the capability and desire to share newly acquired knowledge and techniques with other teachers of undergraduate students. Participants must agree to participate in the academic year follow—up activities and the summer 1995 reunion. Preference will be given to those who received their highest degree a minimum of five years before the start of the project, women, persons with disabilities, and under—represented minorities.

a. Teaching College Science: Issues and Methods

*Workshop Content.* The purpose of this workshop is to bring college science educators together to raise issues associated with teaching science, and to work cooperatively to understand and develop teaching methods that address those issues. The workshop will be five days in duration and there will be 30 participants who are faculty from chemistry, biology, geology, physics, and engineering sciences from both the UW Centers and the UW—Eau Claire. A team of four UW faculty (two from UW Centers and two from UW—Eau Claire) will act as facilitators. Since the participants and facilitators are all educators, the course will be run in an interactive mode to allow everyone’s voice to be heard. The sessions will be informal with ample opportunity for all to contribute their knowledge. In addition, efforts will be made to give the individuals chances to interact in social and recreational settings.

Sessions during the first several days will emphasize teaching issues found in all science disciplines. This will allow the whole group to work together to understand learning and teaching issues and processes. Subsequently they will interact to comprehend and devise strategies to teach more effectively. Issues such as learning theory, levels of cognitive development, active lecturing, teaching problem solving, critical thinking, and cooperative learning will be addressed. Cooperative group structures will be used to increase participation and encourage individuals to make contacts with each other. Some teaching methods will be modeled during the sessions with the participants acting as students. In addition, an outside expert or two will be bought in to present some aspects of science education (e.g. Dr. Karl Smith of the University of Minnesota on cooperative teaching methods as a keynote speaker, Earl Peace of the UW System as a
presenter). Procedures for assessing the impact of changes in teaching methods on the achievement and attitudes of students will be discussed, too.

As the week progresses, content issues will be brought into the discussions. Some of these will be general science issues, such as uncertainty in science and authority analysis, to be discussed with the entire group. It is also planned to split into discipline—specific groups to allow issues and solutions specific to teaching chemistry, biology, or other disciplines to be raised and discussed. This will also allow individuals in specific disciplines to get to know one another better. Creation of a network of participants is an important workshop goal.

The participants will be expected to implement some of the ideas or methods in their teaching during the next school year. The last day will be spent facilitating the planning process for that implementation. Participants will be grouped according to their interests to discuss the change they intend to try and the methods they’ll use to assess the impact of the changes. It may be possible to devise projects that involve groups of teachers. Information will be provided to enable participants to stay in touch following the workshop to allow them to support each other during the subsequent teaching activities. The goal will be that each participant will have a well developed plan of a new teaching method or strategy that they will try during the next academic year, and a way of assessing the effect of that change. Participants will return to Eau Claire in 1995 to report the results of their project.

Workshop Presenters. Presenters will include Robert Eierman, Professor of Chemistry, UW-Eau Claire; Wilson Taylor, Professor of Biology, UW-Eau Claire; John Albrecht, Assistant Professor of Chemistry, UW Center-Richland; Janet Phelps, Associate Professor of Biology, UW Center-Baraboo/Sauk; and Earl Peace, UW System Academic Planner.

Workshop Logistics. Participants from the UW Centers will car—pool from their campuses. One van or car (or as many as necessary to accommodate the number of travelers) from each campus will be provided by the UW Centers. The car will remain at the workshop site until participants drive back. Lodging will be in a dormitory on the UW—Eau Claire campus. Meals will be served in the dormitory cafeteria, except for a few special events such as a mid-week banquet with keynote speaker. Participants from the UW—Eau Claire will not need travel or lodging, but will participate in some special meals and recreational/social events.

Workshop Schedule.

TEACHING COLLEGE SCIENCE: ISSUES AND METHODS: An NSF-UFE Workshop

NOTE: Sessions will be interactive with leadership by the person named in parentheses.

MONDAY
8:00—9:00 Welcome, introductions and a group building exercise
9:00—10:00 Teaching issues of concern and teaching methods used presently
10:00—10:15 BREAK
10:15—12:00 Active lecturing (Dr. Eierman)
12:00—1:30 Lunch and leisure
1:30—3:30 Learning styles and appropriate teaching methods (Prof. Albrecht)
3:30—3:45 BREAK
3:45—5:00 Guaranteed student success (Dr. Phelps)
Evening Optional informal get-together for recreation and refreshments

TUESDAY
8:00—10:00  Cognitive mapping (Prof. Albrecht)
10:00—10:15 BREAK
10:15—12:00 Communicating expectations (Dr. Phelps)
12:00—1:30  Lunch and Leisure
1:30—3:30 Laboratory teaching structures I (Dr. Eierman)
3:45—5:00 Laboratory teaching structures II (Dr. Taylor)

WEDNESDAY All day workshop on teaching methodology (Earl Peace)
5:30  Banquet with keynote speaker

THURSDAY
8:00—10:00 Biology (Drs. Taylor and Phelps) and Chemistry (Dr. Eierman and Prof. Albrecht)
discipline—specific groups, other discipline-specific groups depending on the
make—up of the participants; lecture issues and methods
10:00—10:15 BREAK
10:15—12:00 Discipline-specific groups, laboratory issues and methods
12:00—1:30  Lunch and Leisure
1:30—3:30 Uncertainty as an integral part of science (Dr. Taylor)
3:30—3:45 BREAK
3:45—5:00 Assessing student achievement and attitude changes (Dr. Eierman)

FRIDAY
8:00—8:30  A teaching research project (Dr. Eierman)
8:30—10:30 Small-group discussion of possible teaching projects
10:30—10:45 BREAK
10:45—12:00 Teaching project interest groups with discussion of assessment
12:00—2:00 Lunch and time to prepare presentation of projects
2:00—3:30 Individuals describe proposed teaching and assessment project
3:30—4:00 Assessment of short course and farewell

b. Environmental Science Workshop

Workshop Content. The purpose of this workshop is to bring college science
educators together to some recent developments in environmental studies and their implications
for freshman—sophomore instruction. The workshop will be five days in duration and there will
be 30 participants who are faculty from chemistry, biology, geology, and engineering sciences
from both the UW Centers and the UW-Green Bay. A team of UW faculty from the UW Centers
and from UW-Green Bay will act as facilitators. UW-Green Bay faculty will be running the
majority of the workshop since we have been unable to find UW Centers faculty with the
expertise required. UW Centers faculty have extensive knowledge about teaching methods
(naturally), but genuinely do not have a lot of expertise in the environmental science area. This
accounts for the difference in staffing of the two workshops. UW Centers faculty are included in
the staffing so that they have a hand in designing the workshop to meet their needs. Since the
participants and facilitators are all educators, the course will be run in an interactive mode to
allow everyone’s voice to be heard. The sessions will be informal with ample opportunity for all
to contribute their knowledge. In addition, efforts will be made to give the individuals chances to
interact in social and recreational settings.

The session will begin with an overview of new developments in global environment, water
resource preservation, and energy conservation. The field of environmental studies is advancing
and expanding so rapidly that inclusion of all recent developments in a one—week seminar
would be impossible, so the seminar will concentrate on a few important developments. The
focus of the seminar will be problems and solutions for landfills and industrial waste sites.
Discussions on this area will include: problems associated with landfills and industrial waste sites; biodegradation of organic waste; recovery of methane for fuel; industrial pollution management; and chemical analysis of inorganic and organic contaminants. Several afternoons will be spent in the laboratory instructing participants on new experimental techniques. Participants will take part in several laboratory exercises that are appropriate for subsequent freshman—sophomore involvement. The latter part of the seminar will focus on taking the acquired knowledge and skills back to home institutions. By the end of the seminar participants will be able to develop curricula and research projects at the freshman—sophomore level.

The participants will be expected to implement some of the ideas or methods in their teaching during the next school year. The last day will be spent discussing new developments in environmental science teaching methods followed by facilitation of the planning process for that implementation. Participants will be grouped according to their interests to discuss the change they intend to try and the methods they’ll use to assess the impact of the changes. It may be possible to devise projects that involve groups of teachers. Information will be provided to enable participants to stay in touch following the workshop to allow them to support each other during the subsequent teaching activities. The goal will be that each participant will have a well developed plan of a new teaching method or strategy that they will try during the next academic year, and a way of assessing the effect of that change. Participants will return to Green Bay in 1995 to report the results of their project.

Workshop Presenters. The environmental science workshop presenters will include James Wiersma and John Lyon, both Professors of Chemistry, UW-Green Bay; Leander Schwartz and Michael Morgan, both Professors of Biology, UW-Green Bay; Janice Alexander and Paul Martino, both Assistant Professors of Chemistry, UW Centers and a UW Centers biologist, yet to be named.

Workshop Logistics: Participants from the UW Centers will car-pool from their campuses. One van or car (or as many as necessary to accommodate the number of travelers) from each campus will be provided by the UW Centers. The car will remain at the workshop site until participants drive back. Lodging will be in a dormitory on the UW-Green Bay campus. Meals will be served in the dormitory cafeteria, except for a few special events such as a mid—week banquet with keynote speaker. Participants from the UW-Green Bay will not need travel or lodging, but will participate in some special meals and recreational/social events.

Workshop Schedule:

ENVIRONMENTAL SCIENCE WORKSHOP

MONDAY (Presenters are indicated in parenthesis)

MORNING: (Wiersma, Morgan)

Welcome, introductions, group discussion of what is currently being taught in the area of environmental studies and what the participants would like to see in the way of new methods. An introduction of new developments in global environment, water resource preservation, and energy conversion.

AFTERNOON: (Schwarz, Morgan)

An overview of the microbial ecosystem and environmental factors which affect the anaerobic degradation of organic wastes. Examination of the potential advantages of anaerobic
treatment of liquid and solid waste including energy recovery from landfills. Biotic responses to global warming.

**TUESDAY**

**MORNING:** (Schwarz, geologist)

Field trip to the Outagamie County landfill to observe energy recovery by utilization of methane. Visit to industrial waste sites and sample collection.

**AFTERNOON:** (Schwarz, UW Centers biologist)

Monitoring of a functioning anaerobic reactor. Lab analysis by gas chromatography (GC) of glucose and fatty acids.

**WEDNESDAY**

**MORNING:** (Wiersma, Lyon)

Discussion sections on the environmental redox chemistry of nitrogen compounds in aerobic and anaerobic environments, methods for the analysis of heavy metals and pesticides, dealing with PCB’s and heavy metals in dredge spoil disposal.

**AFTERNOON:** (Wiersma, Lyon, Alexander, Martino)

Lab analysis of heavy metals and pesticides including GC—FID and high pressure liquid chromatography (HPLC).

**THURSDAY**

**MORNING:** (Nancy Sell — engineering)

General overview of industrial pollution and its control. Industrial pollution and its control for specific industries in Wisconsin.

**AFTERNOON:** (Wiersma, Lyon, Alexander, Martino)

Lab analysis of heavy metals and pesticides including GC—FID and HPLC.

**EVENING:** Banquet with keynote speaker.

**FRIDAY**

**MORNING:** (Morgan)

The teaching of environmental science.

**AFTERNOON:**


2. **Follow—up Activities During the Academic Year**

At the end of the fall Semester, each participant will send a 2—6 page report to the Project Director. The report will cover two topics: 1) what materials and ideas from the workshop the participant introduced into his or her classes, and with what result; and 2) whether
the participant has begun any collaborative research or other professional activities with faculty on the other campus.

There will be a two weekend reunions, one in Eau Claire and one in Green Bay in May, 1995, at the conclusion of the academic year. Each participant will present a 20—25 minute summary (including 5—10 minutes for questions) of how they integrated what they took home from the workshop into their classes. Ideally, the talk will be illustrated with slides, transparencies or other AV aids. Each participant will also prepare a written summary (8 single spaced pages maximum, plus appended course materials) relating what they did, how the students responded, and what they will do differently the next time. Participants will also be asked to indicate whether they have begun any collaborative work or other professional activity with faculty from the other campus. All the participants’ materials will be assembled into one report, with a copy to each participant by the next fall.

B. The Setting: Facilities and Equipment Available

The UW—Eau Claire and the UW—Green Bay have all the facilities and equipment necessary for the project. The UW—Eau Claire has 26 modern buildings located on a 333— acre campus. There are extensive resources, including laboratories with the latest equipment, a planetarium, an observatory, greenhouses, theaters, exhibition centers, and a media development center. The UW—Green Bay has 12 major buildings on 700 acres. All buildings are connected by underground passages—ways which are very handicapped— accessible. The UW—GB has extensive resources, including a large arboretum which is used for recreation and research, and fully-equipped laboratories for biology, chemistry, computer science, and physics. The UW—GB recently received a grant to augment its molecular and biology laboratories through an NSF—ILL grant. Both the UW—Eau Claire and the UW— Green Bay maintain an intellectual setting conducive to learning by a group of mature professionals (especially in the summer, when there are relatively few undergraduates on campus!).

C. Project Administration. There will be one Project Director and one Project Co—Director who will do the organizational work necessary to the project. The other senior personnel listed on the budget page are workshop presenters. For a list of some of the tasks to be done, and the anticipated calendar for getting them done, see the Administrative Timetable (Appendix E). Careful supervision is required to coordinate people on 15 different campuses, to ensure that each workshop is organized to reach project objectives. The Project Director and Co—Director must also organize the summer 1995 reunion, and complete the evaluation during the summer of 1995. Both the Project Director and the Co—Director take a one quarter release in the spring semester 1994. Both will also devote at least two in the summer of 1994 to the workshops and the initial evaluations. They will both devote at least four weeks in the summer of 1995 for the reunion and the final evaluation.

Qualifications of Key Personnel. See Curriculum Vitae in Biographical Sketch.

Janice Alexander, the Project Director, has a doctorate in chemistry from the University of Virginia (1991) and has published in such journals as Peptides and the Journal of Forensic Sciences. She is Assistant Professor of Chemistry at the University of Wisconsin Centers—Fox Valley, where she teaches general chemistry and quantitative analysis.

Paul A. Martino, the Project Co—Director, has a doctorate in chemistry from the University of Virginia (1991) and has published in such journals as the Journal of the American Society of Mass Spectrometry. He is Assistant Professor of Chemistry at the University of Wisconsin Centers-Manitowoc, where he teaches general chemistry, organic chemistry, and biochemistry. He helped to develop these courses on his campus.
During the summer of 1992, Alexander and Martino participated in a 3-week workshop funded by the National Science Foundation Undergraduate Faculty Enhancement program, and sponsored by the Great Lakes Research Consortium at SUNY-Oswego, New York. The workshop focused on environmental problem solving as an effective teaching strategy to stimulate undergraduates’ interest in environmental science.