

Associated Colleges of the South (ACS)  
Phase II Proposal for the W.M. Keck Foundation  
Focusing on the Reform of Science Education for Non-Science Majors  
March 2003

### **The Request**

The Associated Colleges of the South, a consortium of sixteen liberal arts institutions in twelve southern states, requests funding in the amount of \$500,000, from the W.M. Keck Foundation. These funds will be used over a three-year period to design, to implement, to assess, and to share new models for science courses, primarily in the natural sciences, for non-science majors on the sixteen ACS campuses. Strategies include course assessment and design, assessment of the value undergraduate students place on science literacy, faculty training in evaluation, exposure to issues in non-majors science education, application of technology in science courses, and information exchange/dissemination opportunities. These models will be suitable for replication by non-ACS post-secondary institutions. In addition, this basic funding will enable ACS to seek funding from other foundations for two additional years of crucial training, benchmarking, and dissemination opportunities.

Trinity University, San Antonio, Texas, will be the recipient of the funds on behalf of ACS.

### **Why ACS and Trinity**

The ACS faculty and administrators feel very strongly that liberal arts colleges, in particular, should be making the innovative effort described in this proposal. Our institutions pride themselves in offering programs at the highest level of rigor and quality, and science education for non-majors needs to be raised to this level. Moreover, liberal arts colleges like those in the ACS are committed to providing a broad based core curriculum that will equip students for their optimal professional and personal development. A solid science background is an integral part of this preparation, and a liberal arts education would be short-changed and undermined without it. The personal attention given to students in a liberal arts setting, the close interaction between faculty and students, the opportunity for firsthand access to laboratory equipment and experiences bodes well for student literacy and fluency in science. The ACS institutions can put basic science education in front of all of its students, not just students majoring in sciences.

The presidents, deans, faculty, and staff at ACS member institutions constantly scan their respective campuses to identify the most critical and pressing needs as well as opportunities to strengthen their programs in significant ways. Approximately six years ago, undergraduate science education rose to the surface in these explorations. In subsequent and widespread consultations with faculty and administrators on ACS campuses, a clear interest in undergraduate science education emerged, particularly in terms of what could be accomplished for the non-major.

It is important to note that the interest in science education among the ACS institutions arose from the institutions themselves; it was not generated by the ACS staff. The individual institutions realized that, while they were responding to undergraduate science education for non-majors in a variety of ways, they could respond more constructively and powerfully if they worked together. Collaboration would help them avoid re-creating the proverbial wheel, avoid duplicating each other's efforts, minimize redundancy in efforts and programs, and draw on each

other's expertise, experience, and creativity. In mobilizing the resources of the sixteen ACS institutions, they felt they could devise optimal programs that would serve as a model for other institutions and consortia throughout the country and beyond. Since 1997 a core group of both ACS faculty and academic deans have been planning, testing, and evaluating the underlying principles of this proposal and now are ready to introduce revised and new introductory science courses for non-majors. Other ACS faculty and administrators are ready to initiate formative course assessment and redesign of both existing and recently implemented courses. This six-year period of planning demonstrates the commitment of the faculty and administrators at the ACS member institutions to improve science education, especially for non-science majors.

Institutional and administrative confidence in this effort is bolstered by the fact that the ACS consortium has a proven, 12 year track record of networking and collaboratively developing, assessing, and implementing consortial programs. Our sixteen campuses currently interact and collaborate with each other through numerous programs, including study abroad, faculty development, technology, information fluency, women's/ gender studies, environmental studies, and virtual departments in music and the classics. We have cooperated to build networks of faculty who work together successfully. For example, ACS brought the classicists together into a new "virtual department," where courses are jointly taught, opportunities are broadened, new courses are introduced, faculty are able to teach courses that they have not been able to teach, new faculty development opportunities are opened up, sabbaticals and faculty exchanges are organized, and program evaluation is implemented. While there are one or two classicists on a typical campus, ACS offers 30 faculty members to its students and a wide array of courses and opportunities that otherwise would not have been available. Collaborative efforts within ACS also have been mounted in other areas as well, including modern languages and Latin American Studies. In women's/gender and environmental studies, for example, there have been extensive information exchanges, numerous conferences and workshops, joint faculty and student research, co-curricular opportunities linked with academic programs, and the constructive and innovative incorporation of technology. Most important in these endeavors is the fact that students are better educated in very important areas.

Additionally, the consortium offers the opportunity to magnify the impact of what is being proposed. The ACS is proposing to create introductory science courses for non-majors that will impact some 30,000 students rather than the 1,000 to 1,500 students on most of the individual member campuses. The consortium, as suggested earlier, can attract a wide array of experienced and imaginative talent, stimulate creativity, and forge new approaches for undergraduate students in science education. Such collaboration forms a critical mass of able faculty members who ask the difficult questions, generate more ideas, draw on more experience and perspectives, and develop courses and programs that truly make a difference in the lives of the students.

Trinity University is a key player in this scenario because it volunteered to serve as the lead institution for this project. Like the other institutions in the consortium, Trinity is committed to undergraduate science education at the highest level. From the outset of this effort, Dr. Ed Roy, former vice president for academic affairs and now professor of geology at Trinity, has taken a principal role in organizing this effort. The president, academic vice president and others at Trinity have been keenly interested in this project from the beginning, even hosting the second ACS conference on this subject, in 1998, that brought together science faculty from a wide variety of consortial institutions to explore how the concept of scientific citizenship could become a reality in undergraduate education. Given this history, it has been clear to the ACS consortium that Trinity is very willing and should continue to play a catalytic role as the liaison institution for the group as a whole in this science education program.

Drawing on the urgent need to address concerns in undergraduate science education for non-majors and the demonstrated and successful collaborative efforts within ACS, the faculty, administrators, and staff in the consortium feel confident about cooperation as applied primarily to the natural sciences. This is an opportunity for the remarkable synergy of interested institutions and a consortial partner that has intense interest in science and a track record of linking faculty together in extraordinary new ways to raise the visibility of needs in science education, create useful models, establish partnerships on a broader scale, even beyond the consortium, and enlarge the potential for future funding from a variety of sources. With the support of the W.M. Keck Foundation, we believe that individual, institutional, and national needs can be met in a most compelling way.

### **Why the W.M. Keck Foundation**

This proposal is submitted to the W. M. Keck Foundation because of the Foundation's keen interest in innovative science programs; a well-rounded, high-quality education for college students in a liberal arts setting; and the encouragement that members of the Foundation staff have given the ACS over the past four years to develop and to refine this program. The W.M. Keck Foundation is held in high regard by the ACS member institutions, and the funding of this proposal by the Foundation would stimulate the interest and boost the participation of faculty and institutions in this initiative. Furthermore, a grant from the W.M. Keck Foundation will open linkages and channels to faculty, organizations, institutions, and other groups outside of the consortium with whom collaborative efforts in science literacy and fluency may be forged.

### **Background -The Nature of the Problem**

*The problem emerges not so much in the quality of majors as in those who enroll in science with more general knowledge. There are too many elementary and secondary school teachers who are frightened by and even resentful of science as a result of their undergraduate experiences; there is too little practical understanding by college educated parents of the importance of science in either their own or their children's lives; and there are too many educated policy-makers who bring in alarmingly insufficient understanding of science to the pursuit of their own agenda.*

Pew Policy Perspectives, June 1998

The above conclusion, reported in the Pew Policy Perspective of June, 1998, also was reached by the ACS science faculty, from eleven institutions, who attended the first ACS consortial workshop on science education at Birmingham-Southern College in 1998. At that workshop, a program director for undergraduate education at the National Science Foundation emphasized that the major issue confronting science education in this country today is not one of an inadequate supply of well-trained scientists and engineers, but rather the scientific literacy, or illiteracy, of non-scientists. Reports from the National Science Foundation, the National Academy of Sciences, the Pew Charitable Trust and others have reinforced this view. And it was underscored by the ACS science faculty members, representing thirteen ACS institutions, who attended the second education planning workshop held by the ACS consortium in June 2000, at Trinity University, San Antonio, Texas.

The fact remains that the general American populace, including college graduates, has a very poor understanding of science, which impedes discernment of the role science plays in national and international policy, as well as in personal and business pursuits. Furthermore, the southern states historically have lagged behind the rest of the country in science education. This region currently is engaged in a major reform of its K-16 science education programs, with Kentucky, Texas, Louisiana, and Georgia in the forefront of this movement.

ACS colleges and universities came to the realization that they needed to undertake a serious look at their undergraduate science courses for non-majors. Not only is science literacy and fluency a critical and urgent problem in general, it also is important for the ACS institutions, from the standpoint of being true to and fulfilling their institutional missions, as they prepare students to be capable and effective citizens of the world.

In order to address institutional concerns, multiple aspects of course design and content must be considered, including the related laboratory research and field experiences, faculty development needs and opportunities, appropriate and creative roles for technology, and the potential impact of collaboration among faculty and institutions. Several ACS member institutions, including Trinity University, Birmingham-Southern College, Furman University, Centenary College of Louisiana, and the University of Richmond have been at the forefront of this effort within the consortium and have served as pilot institutions.

Since the targeted students for this project are not majoring in science, we are not looking for specialized science expertise to be one of the outcomes. The students in our lens are not likely to enter graduate school and seek masters and doctoral degrees in any of the sciences. Nor are they likely to seek scientific jobs immediately after college. Rather, the students on whom we are concentrating may proceed to graduate or professional schools in other disciplines or will follow a broad range of career paths. While none of these paths may primarily emphasize scientific understanding, science is likely to come into play in a myriad of ways.

Science may enable a business person to better understand his/her product, the scientific underpinnings of that product and the environment in which the product may be grown, manufactured, and/or used. A basic understanding of science could help an attorney deal with a case with scientific implications, equipping the attorney to fully comprehend what happened in the circumstance at hand and evaluate the nature and impact of scientific evidence and testimony. The perspectives of any K-12 teacher can be widened by an acquaintance with science. For instance, a social studies teacher or a political scientist could derive significant benefit by applying basic scientific understanding to issues of national security that involve nuclear, biological, and chemical warfare. In these areas, as in others, being literate and fluent in science strengthens one's professional capabilities and enables our graduates to serve as empowered citizens as they are called upon to evaluate a vast array of complicated issues facing society at-large. The graduate who is literate and fluent in science will be able to articulate basic key scientific principles, identify major sources of scientific information, access useful information and be able to distinguish between authentic and bogus notions about science.

### **Project Mission and Purpose**

This initiative's mission is to:

- Increase the visibility and to sharpen the focus on issues in science education across the sixteen ACS campuses.
- Provide the ACS faculty with the expertise and the resources to raise the level of science literacy among non-science majors.

- Improve the scientific and technological understanding and skills of non-science majors.
- Demonstrate the value of confronting this problem through collaborative efforts among the sixteen ACS member institutions.

With funding, all sixteen ACS institutions will be invited to develop and to revise introductory science courses and related activities, to assess the value that non-major science students place on science literacy, to enhance faculty development, to identify and to integrate appropriate and creative roles for technology, and to showcase the potential impact of collaboration among faculty and institutions as they prepare students to be effective local and world citizens.

### **Project Objectives**

There are two objectives at the heart of this undergraduate science initiative for non-majors:

1. to raise the level of science literacy of students at ACS member institutions, and
2. to demonstrate the value of confronting this difficult and perplexing problem through collaborative efforts of faculty and institutions.

These objectives will be accomplished by:

- assisting ACS member institutions in the development of new courses and in the review and redesign of existing introductory science courses for non-majors, by training faculty members in course design and assessment.
- expanding the orientation and mentoring of new science faculty to include special seminars to address such topics as the educational needs of non-science majors, new courses, and pedagogical approaches that are appropriate for this audience and these courses.
- sharing, across the consortium, the models that already have been created and tested by member institutions.
- developing new, experiential, investigative models for introductory, undergraduate science courses, as well as for the research, laboratory, and field-based components of such courses.
- identifying and including the appropriate and creative applications of existing and emerging technology in the science courses and field-based components.
- partnering with colleagues at Drury University to pilot the first comprehensive Science and Math Values Inventory (SaM-VI).
- evaluating the individual projects as well as the program as a whole and distilling best practices and lessons learned in specific courses and on the initiative as a whole.
- disseminating the results of this initiative within and outside the consortium, via electronic means, professional journals, presentations at professional meetings and workshops that include non-ACS institutions.

## **Program Organization and Oversight**

A program committee, with science faculty representation from all sixteen ACS institutions, will guide the project, receive and generate reports, and receive applications and award funding for course implementation, course redesign and evaluation, and new course development. Selection of the committee members will follow the consortial guidelines, in which the ACS Council of Deans takes the lead in identifying knowledgeable and interested persons for committee membership. Since the ACS Council of Deans is charged with general and ongoing oversight of all ACS programs, the Science Education Program Committee will work closely with the ACS Council of Deans. The committee will make regular reports to the Council of Deans and provide updates as needed between the Council's three regularly scheduled meetings per year.

The ACS Council of Deans will identify potential participants on the campuses and encourage them to take an active part in preparing proposals, in designing more courses, and in implementation. They also will strongly encourage new science faculty to become involved in the project; will promote participation in consortium-wide workshops, seminars and conferences; and will promote collaboration to make sure that the evaluation activities are effectively carried out.

The ACS presidents, who meet annually, also will be consulted regularly and kept informed via written and electronic reports.

Knowledgeable, outside evaluators will be engaged at strategic points to consult with the program committee, as well as with participating faculty and institutions. Atlanta-based staff will support all phases of the project, coordinating the various efforts to take place. This will include working with the deans to identify participants, gathering and distributing information about the on-campus activities, working with the program committee to develop fully the grant selection process and the circuit rider program, engaging the services of outside evaluators, and monitoring the evaluation process.

All of the persons involved with planning and oversight responsibilities will work collaboratively to stimulate maximum participation.

## **Dissemination and Evaluation**

The ACS is serious about creating a paradigm for science collaboration that can be replicated elsewhere and thereby magnify the impact of this particular initiative. The consortium has a model of its own in mind, after which it can pattern this initiative in science literacy and fluency. For example, in environmental studies, the ACS consortium established six separate alliances, bringing together faculty and staff from the member institutions. Each alliance works in the area of its special interest, sharing the results of its labor with all of the member institutions.

The most relevant and parallel alliance for this science proposal is the environmental academic program and curriculum alliance. In this group, faculty have devised specific courses and modules for courses and have provided financial resources to faculty to enable them to carry out their collaborative work. Individual and joint research activities have been promoted. Teleconferences have been arranged and workshops have been held. In these workshops, it should be noted, faculty have exchanged information for their general edification and also have worked intensively on creating joint courses and modules. Alliance participants have joined together in reviewing the relevant majors, minors, and concentrations in order to design curricula that fit the interest and needs of a variety of students. Like our science initiative, the emphasis has

been placed on the non-major. This approach has worked in the ACS environmental program, as it will in our proposed science endeavor.

The ACS plans to engage in both internal and external evaluations of this initiative. An internal coordinating group will evaluate all of the individual efforts, including courses and workshops. Internal and/or external evaluators may be engaged to look at selected course objectives, syllabi, readings, talk with students, and offer suggestions for ways to enhance campus and consortial efforts. External evaluators will be asked to review individual aspects of the initiative, as well as the program as a whole. Both internal and external evaluators will be asked to provide feedback along the way, making this a formative evaluation from which the group can learn as it proceeds. Corrections can be made as needed and strong points can be accentuated as the group strives to meet its overall purpose, mission, and objectives. This evaluation effort will be put into place within the first year of the program and will continue throughout the initiative.

In following this procedure, the consortium will benefit from considerable experience. For example, in the ACS classics initiative an on-going internal review takes place while outside evaluators meet with all of the participants in the program, review documents, and offer helpful commentary. This process has worked exceptionally well in the classics, environmental studies and other consortial programs and will provide a useful model for this science initiative.

The consortium feels that it is extremely important to disseminate information on this innovative undertaking, both internally and externally. Consequently, considerable information will flow about the cooperative process so that member and non-member institutions may consider such a model in the future. The program committee and the consortium will endeavor to be both effective and prudent in its dissemination efforts, as it seeks to share its learnings, models, and the significant results of this initiative. A variety of means, including electronic mechanisms, print materials, special dissemination workshops, and panel presentations at professional meetings, will be used to disseminate information.

Internally, information will be shared with all sixteen institutions through workshops, seminars, conferences; reports to various constituent groups; web pages dedicated to this initiative; the ACS print publication called *The Palladian*; and the electronic news update mechanism known as the *e-Palladian*. The program committee will be encouraged to develop something like an informational seminar that can be transported to individual campuses, to use as both a recruitment and a dissemination tool.

The consortium will disseminate widely reports on courses initiated, the special orientation programs created and the workshops and conferences held. Dissemination venues include, but are not limited to:

- Disciplinary professional journals, such as the *Journal of College Science Teaching*, the *American Biology Teacher*, and the *Journal of Chemical Education, Biochemistry and Molecular Biology Education*.
- Annual disciplinary professional meetings, such as the Association for Biology Laboratory Education (ABLE), the Association of Southeastern Biologists, the American Chemical Society, and the Federation of American Societies for Experimental Biology.
- State and regional meetings of professional science groups.

This dissemination process will enable the consortium to share its “best practices” with others who may be particularly interested. At the same time, the dissemination effort will help to create linkages with other groups with whom the ACS may want to work in the future. The consortium

will continue to look for ways of forging new partnerships and broadening the impact and influence of its effort.

### **The Specific Proposal**

As a result of its planning workshops and introduction of pilot courses on member campuses, the ACS proposes an initial three-year schedule of assessment, design, implementation, revision, and dissemination.

#### **Year One - Academic Year 2003-2004**

1. Course Implementation of new and redesigned disciplinary and interdisciplinary courses, both disciplinary and interdisciplinary in nature, which resulted from the early planning efforts, will be implemented during Fall 2003 and Spring 2004. The program committee anticipates providing “mini-grants” to selected faculty to facilitate implementation of two new courses or modules, the review and redesign of two pilot courses or modules, and the design of two new courses or modules. The mini-grants may include funds for such items as stipends for faculty reassigned time and development, materials, resources, assessment, and consulting assistance. Preliminary Guidelines and Criteria for the selection process are found in Appendix C.

Examples of course implementation and redesign efforts from Trinity University, Birmingham-Southern College, and Furman University are included below. Additional examples from these three institutions and the University of Richmond, including anticipated new courses or modules for design and implementation, are included in Appendix D.

A. *Trinity University, San Antonio, Texas*, is replacing its traditional physical geology course with a new “Exploring the Earth” course (GEOS 1307). The course is structured around a series of student investigative projects with supporting lecture and discussion sessions. For example, one project will focus on the physical properties and structures of minerals and the use of minerals by society. Basic concepts of mineralogy and x-ray diffraction techniques will be presented in lecture. Then students will investigate the common household materials using x-ray diffraction equipment. New desktop computers will allow students to identify minerals present in a variety of cleaning products, understand crystal structures and properties, and appreciate the utility of different minerals in a variety of products.

Instrumental data collection and quantitative analysis will be introduced using new equipment: GPS receivers, Brunton compasses, and GIS software. Using GPS receivers, students will be able to calculate the dimensions of the earth on the first day of the course. GPS receivers coupled with stream flow current meters and the department’s 24-channel seismograph will enable students to study the nature of stream flow and the effects of flood control structures on the floodplain adjacent to the campus. Using student-generated and existing maps, students will sample surface and ground waters from multiple locations and analyze these samples using the new atomic absorption spectrophotometer shared with the Chemistry Department. Students will discover that water chemistry varies as a function of the geologic setting from which the sample was collected and develop hypotheses that explain the variations in water chemistry.

In another GEOS 1307 course unit yet to be developed, new equipment that currently is being ordered, stereo-binocular and polarizing microscopes and desktop computers, will be used in the analysis of detrital sedimentary rocks. Specific experiments will be designed in the next 12-

15 months, and Trinity expects to undertake a three to five year assessment period after full implementation of the course.

The second course in this introductory sequence, Earth History (GEOS 2401), adds the dimension of time to the study of the Earth. Taught in an integrated lecture and laboratory format, the course investigates the evolution of the earth and its inhabitants. Investigations of absolute and relative geochronology, stratigraphy and biostratigraphy, the genesis of continents and oceans, and the history of life will be included in the laboratory. Students will collect data from rock and fossil samples using both the stereo-binocular microscopes and the polarizing microscopes, and analyze the data using the computers. The use of computer models will permit students to investigate the Earth and its systems through past geologic times, as well as to make predictions about future global change.

B. Birmingham Southern College, Birmingham, Alabama, is replacing its lecture oriented Chemistry 101 course, with a course focused on real environmental issues. Based on the American Chemical Society's "Chemistry in Context" program, chemical principles are presented in the context of topics such as air and water quality, global warming, the ozone layer, acid rain, and energy sources. These topics lend themselves to a multidisciplinary approach and create collaborative opportunities for physics, biology, political science, and economics faculty. The new design includes group activities, writing assignments, discussion topics, and open-ended inquiry lab experiences. In addition, there are many computer-based activities which can be incorporated into the course, such as downloading data from NASA on the ozone hole and using computer models to simulate the data. The course truly will be student centered and focused on cooperative learning.

C. In the 2001-02 academic year, Furman University, Greenville, South Carolina, implemented a revised "Principles of Biology" course with topical based modules and suitable lab experiences. Topics tested were: "Microbes: Our Ubiquitous Allies," "Biology for Everyday Living," "The Biology of Disease," and "Human Biology." In each of these, students were exposed to the basic topics of cellular and molecular biology, genetics, organismal physiology, ecology, and evolution. Student evaluations were quite positive and noted the relevance of the topics to everyday life and decision making.

In Spring 2003, another specialized section, "Biological Diversity," will be taught. This will focus on the diversity of living systems, from their evolution to their complex interactions with each other and with the environment. The biological principles explored in the class will be put in perspective by making connections with other disciplines. Furthermore, students will be asked to make connections between this class and their field of study.

In the fall of 2003, a fifth topic will be introduced. Tentatively titled "Living in the Age of Insects," this four credit hour course will introduce students to the four major areas of biology: molecular and cellular biology, physiology, genetics, ecology, plus the evolution and diversity of life, while focusing on the most diverse group of organisms on Earth, the insects. Of special interest will be the exploration of how insects interact with humans, for our good and to our detriment--indeed, how they have heavily influenced human history. Laboratory and field work will involve insects and their environments.

3. A course design and assessment workshop will prepare ACS faculty to develop and to evaluate their science courses, design new courses, and revise/redesign existing courses, all for non-majors. A two day workshop will occur as soon as possible after receiving the grant, in late

summer or early fall 2003. While the participant recruitment for this first workshop will emphasize ACS institutions offering new (or revised) introductory courses for non-majors either in the Fall of 2003 or the Spring of 2004, attendance will be open to other ACS natural science faculty teaching introductory courses for non-majors. The agenda would include, but not be limited to the following:

- Identification and discussion of the goals they have in common, experiences they have had thus far in assessing and designing courses, and experiences with the implementation of revised courses.
- Presentation and discussion of the philosophy of experiential, investigative courses for non-majors by presenting model courses that already have been implemented, undergone formative evaluation, and revised as a result of that assessment.
- Development/agreement upon pre/post assessment inventories to be used with students in these courses. Faculty also would be trained in how to administer and to use these assessment tools and how the data will be collected, processed, and shared. Areas of assessment would include:
  - a. Science Content - how much accurate knowledge students bring into the classroom.
  - b. Science Process - what understanding of the science process/methodology do students bring with them to introductory courses. Perhaps even design (by discipline) a short (10 minute) problem for students to solve at the beginning of the course and again at the end to evaluate what they have learned about scientific process during the course.
  - c. Science Values/Attitudes - what attitudes/values about science do students have at the beginning and at the end of the course? What, if any, changes have taken place? We will collaborate with our colleagues at Drury University, Springfield, Missouri, to pilot the comprehensive Science and Math Values Inventory (SaM-VI). Administered before students take their first science course, this instrument is designed to provide reliable and valid data that will assist in the review and modification of undergraduate science curriculum for non-majors, by identifying topics and approaches that may better reach students.  
Those attending this early workshop would adapt the existing 80 item inventory for use at the ACS institutions.
- Training for “student focus group interviews” that would be used about midway through a term. In these “interviews,” someone other than the faculty on record meets with the students in a designated class to talk with them about how the course is going, what is and is not working, whether or not the course goals are being met, what might be changed to better meet the goals, etc. Answers are recorded, summarized, and shared with the instructor who is teaching the course. The instructor then can make corrections, if needed, to address particular concerns. Questions to ask during these focus group interviews would be predetermined for standardization.
- Principles of Design for Introductory College Courses, including the seven principles for good practice in undergraduate education. See Appendix E for more details about principles of design and the seven principles for good practice in undergraduate education.

Faculty attending this workshop will be asked to serve as resource persons on their respective campuses, disseminating the information from the conference and assisting others in course design.

3. New Science Faculty Orientation, Training, Mentoring would, in the first year, target faculty members in the first 3-5 years of their teaching careers. Academic Deans would be asked to identify science faculty who fit this definition. Orientation, training, and mentoring will take a variety of forms. One possibility is a series of rotating, on-campus seminars that would address various topics of importance and interest to new faculty. The first seminar would be held during the late fall or spring of Year One. A Program committee member or an outside “expert” may provide leadership for the seminar leadership. Topics may include such issues as the purposes and goals of this grant, needs of the non-major science student in introductory science courses, the seven principles of good practice in undergraduate education, collaborative learning, designing and preparing students for interactive learning, the effective use of technology, learning styles, teaching styles, assessing interactive learning, and the real meaning of course evaluations. In addition, the chief academic officers would be asked to identify new science faculty who then would be surveyed to gain information about the topics that are of most interest to them as they teach these introductory courses. Their suggested topics then would be incorporated into these seminars. It is anticipated that these seminars will build a community among the new natural science faculty in the ACS, which should stimulate collaborative work in the future.

Mentoring also would be offered by having experienced ACS science faculty available to consult with new science faculty on course design, evaluation, a lab session or project, student concerns, or faculty/student research and publication. A mentor/mentee relationship would be established between a science faculty member from the new faculty’s own campus or from another ACS campus. A mentoring relationship also would help a new science faculty member identify and initiate beneficial contacts within his/her professional society, including research and publication contacts.

While the majority of new faculty are well trained in their discipline, graduate school does not always prepare them to teach course content and to interact with students, especially non-majors. Mentoring relationships provide support and help for new faculty who must learn a great deal about students, teaching, and the academy in a short period of time. Such relationships also may encourage new faculty to examine a broader range of approaches to a course or to a problematic situation, search for and use creative approaches to teaching and learning, and, in general, be willing to take more positive “risks” for the sake of student learning.

4. A Science Information Exchange Workshop would be held towards the end of the first grant year, in late spring or early summer 2004. Part of the workshop would include time for a post-test follow-up session for the faculty who, as a result of the Course Design and Assessment Workshop held early in Year One, used the SaM-VI and other assessment tools in their classes in the spring of 2004. Through the sharing and analysis of the data, faculty who used these assessment instruments could determine corrections needed for their courses and become presenters and trainers for other faculty who want to use the SaM-VI and/or the other assessment tools developed.

A major goal of the Information Exchange Workshop would be to bring together ACS science faculty, especially those who have been informed by the first course design and assessment workshop, either by direct participation or through their campus resource person, to

exchange information with their colleagues from across the consortium on their existing or proposed classes, to encourage each other to test new ideas, to assist one another in reshaping and redefining courses, to consider a wide variety of pedagogical and evaluative approaches, and to provide critical cross-fertilization that is the fruit of a collaborative approach. For example, *Centenary College of Louisiana, Shreveport, Louisiana*, will share its experience with a revised Biology 101 course they have offered since fall of 2000. With funds from the Louisiana Board of Regents, Centenary renovated two laboratory rooms, upgraded their technology capabilities, and purchased new Biological sensors and probes, which permit more accurate and sophisticated experiments. The once traditional lecture class now utilizes the guided-inquiry model of learning and includes independent group research. 86% of students completing the course in fall 2000 and more than 87% of those completing it in 2001 rated the course good to excellent. All five of the sections offered for fall 2002 were filled, and an additional section had to be added.

5. Dissemination, telling the story, is an important component of this proposal. Given the critical nature of the problem related to science literacy and fluency, colleges and universities are searching for models that work. They do not want to reinvent the wheel, nor should they have to. The ACS always has been willing to share results of its projects with individuals, other consortia, professional groups, and ACS member and non-member colleges and universities. The ACS will share its work in this project through presentations at professional meetings, conferences, and special workshops; electronic communications both internally and externally; and through internal and external publications.

6. A proposed Circuit Rider program supports several aspects of this proposal, including course development, assessment, information exchange, mentoring, and dissemination. Basically, Circuit Riders are faculty with special expertise in given disciplines who are available to visit other ACS campuses where such expertise is needed. It is anticipated that this service will be initiated in the first grant year on a small scale, perhaps beginning with one or two of the natural sciences included in this initiative, and expanded in years two and three. This proposed program would enable science faculty from one ACS campus to visit another ACS campus to share views and experiences; help design and organize science courses for non-majors; stimulate planning efforts; and help to evaluate courses, modules, and other initiatives. Visits may be very general or discipline specific. For example, chemists might assist other chemists with course design and implementation and biologists might share with other biologists the course modules they have developed.

The ACS has experience with such a circuit rider program, which has been very successful in the area of technology. In this case, an inventory of campus needs was created and maintained along with an inventory of faculty who were particularly conversant with technology. The ACS staff put these two lists together and invited various faculty to visit specific campuses. The knowledge ACS has learned about this effort and process will be very helpful as it is reproduced in the area of science education. The one-to-two day circuit rider visits have been particularly useful in the application of technology to courses, and we believe this success can be replicated in science.

7. Program Committee Meeting(s) will be held as needed during the first year. The first face-to-face meeting will be organizational in nature and will be held as soon as possible after the grant is received and committee members are identified. Once the fundamental organizational and

program principles are in place, much of the committee work can and will be conducted through emails and conference calls. A second on-site meeting will be held in the first grant year if it is needed to expedite this initiative and the committee's work. It is anticipated that sub-committees, such as a "Mini-Grant Committee" formed to receive and review proposals for course design, review, and implementation, would be created to facilitate specific aspects of the program and make recommendations to the larger program committee. Sub-committee membership for such activities as workshops may change, and even come from outside the program committee membership, depending upon the focus of the event and/or activity. This would enable the committee to invite the most knowledgeable persons in a given area to help design the best possible workshop/activity on a given topic.

### **Year Two - Academic Year 2004-2005**

1. Course Implementation would occur throughout the academic year, and the purposes in Year Two remain the same as in Year One. Two new courses and/or modules would be implemented. Two courses and/or modules would be reviewed and/or redesigned. Three new courses and/or modules would be designed. These activities would take place throughout the academic year, with stipends being made available to faculty for release time, consultations, materials, and resources.

2. Course Review/Implementation Workshop would be held during the fall term of 2004. This workshop would provide the opportunity for science faculty to come together for in-depth sharing about subject matter, pedagogy, course evaluation, progress of this project, and the development and identification of model courses. This workshop will be a combination of the course design and assessment and information exchange workshops held in Year One. Participants will be a mix of faculty who have implemented new or revised courses during Year One and Year Two and those planning future courses. At this time, expertise on course design, assessment, and revision will be wide-spread throughout the ACS, expanding to all sixteen ACS member institutions.

3. Course Assessment is an on-going activity, throughout the 2005-2006 academic year and the life of this initiative, to assist science faculty with evaluating student learning and the efficacy of their courses, assignments, and laboratory projects. This also involves the continued use of pre/post assessment instruments developed in Year One to assess student understanding of science content, process, and values and attitudes. Activities also may include stipends for faculty to attend specific assessment training offered through the ACS and other higher education organizations. The use of Student Focus Group Interviews will be encouraged as a means of more immediate feedback about course progression, and faculty will be encouraged to make course corrections if needed and as possible. Outside consultants also may be invited to work with selected faculty to evaluate pre-selected courses, syllabi, and readings.

4. New science faculty development, training, and mentoring will be continued through the use of rotating, on site seminars. Topics for such programs will include, but may not be limited to those identified in Year One by the new ACS science faculty as being important to them. Faculty also may be invited to meet by natural science disciplines to discuss common topics of interest and concern, including, but not limited to, needs of the non-science major student; course design; pedagogy; methodology; assessment; the teaching and learning

environment; interactive learning; appropriate use of technology; and experiential, field-based laboratory projects. Leadership will come from within and well as from outside the ACS consortium.

5. Information exchange and dissemination activities will be expanded to reach all sixteen ACS institutions as well as other consortia and post-secondary institutions. Presentations at professional meetings, conferences, and special workshops; submissions to professional publications; and the use of electronic communications, including the ACS website, will be used in this endeavor.

6. The Circuit Rider Program will be expanded and implemented throughout Year Two and will include course development, assessment, information exchange, mentoring, and dissemination for the natural science disciplines included in this program.

7. Program Committee Meeting(s) will be held at least annually to receive and make reports, to identify issues/topics to be addressed in program activities, to approve “mini-grants” for faculty work on course design/redesign, assessment, and implementation, and other business as may emerge. Sub-committees will continue to design and implement workshops, dissemination efforts, and data collection and sharing.

### **Year Three - Academic Year 2005-2006**

1. Course Implementation will continue throughout the fall, spring, and summer of 2005-2006. Implement three new courses. Review and redesign one course. Design two new courses.

2. Science Faculty Development, Training, and Mentoring will continue throughout the fall, spring, and summer of 2005-2006. Expand the orientation and the mentoring of new science faculty begun in Years One and Two to include special seminars for all natural science faculty on individual campuses. Topics will include educational needs of non-science majors, new courses, pedagogical approaches, gathering information from ACS colleagues, and assessing their own teaching efforts in such courses.

3. Course Assessment - is an on-going activity, throughout the year and the life of this initiative, to assist science faculty with evaluating student learning and the efficacy of their courses, assignments, and laboratory projects. This also involves the continued use of pre/post assessment instruments developed in Year One to assess student understanding of science content, process, and values and attitudes. Activities also may include stipends for faculty to attend specific assessment training offered through other higher education organizations. The use of Student Focus Group Interviews will be encouraged as a means of more immediate feedback about course progression, and faculty will be encouraged to make course corrections if needed and as possible. Outside consultants will be used to assist in this process.

4. Information Exchange and Dissemination will continue throughout the 2005-2006 academic year. We will continue to share the results (to date) of this initiative within and outside the consortium, using the internet, professional journals, print publications, presentations at professional meetings, and workshops for ACS and non-ACS faculty.

5. Assessment of the full three year initiative will be conducted during the fall and spring of 2005-2006. A Third Year Report will be issued in the summer of 2006, when the grant ends, distilling best practices and lessons learned on specific courses and on the project as a whole. This assessment will be the responsibility of the Program Committee, with the assistance of a consultant retained for this purpose.

6. Circuit Rider Program - Continue will continue to operate throughout the 2005-2006 academic year, for the benefit of natural science faculty at ACS member institutions, in such areas as course development, assessment, information exchange, mentoring, and dissemination.

7. Program Committee Meeting(s) will be held once or twice during the 2005-2006 academic year to receive and to generate reports; to evaluate the program as a whole; to plan activities in Years Four and Five related to science education and fluency; and to encourage continued course assessment, course design and redesign, course implementation, and dissemination of the work that has and continues to be done as a result of the grant from the W.M. Keck Foundation.

### **Years Four and Five - Academic Years 2006-2008**

Years four and five serve multiple purposes. They will be used to continue to assess and refine courses, implement new courses, train faculty, share project information and collect data to assess the extent to which students are achieving a level of scientific understanding.

The ACS institutions are thoroughly committed to this promising new initiative and are determined to see that it will be sustained. With this in mind, we will be looking for additional funding to extend the program to years four and five. In addition, the institutions expect to institutionalize and absorb the various new courses being designed and the new programs being offered. Furthermore, through the consortium, the member institutions commit themselves to an on-going exchange of information through conferences, workshops, e-mail lists, presentations at professional meetings, and other means. As they implement programs that are designed toward the latter part of this project, the institutions will encourage and support new efforts in course design and faculty development. For example, they are determined to establish a regular and on-going process of orientation for new science faculty who enter the institutions.

### **Selection Criteria for Support of New Courses/Modules and Course Implementation and Redesign**

Mini-grants will be available to science faculty who submit proposals and are selected to develop new courses, to engage in course evaluation and redesign, and/or to implement courses/modules. This relates to item # 1 in each year of the projected budget. Proposal submission and selection criteria will be developed and disseminated widely throughout the consortia to encourage science faculty to participate in this critical aspect of the proposal. The academic deans also will identify and encourage science faculty to participate in this process. Sample submission and selection criteria will be found in Appendix C of this document.

### **Acknowledging a Grant from the W. M. Keck Foundation**

The ACS president and staff will work closely with W.M. Keck Foundation staff to properly acknowledge the receipt of grant funding. Upon notification of a grant award, a draft press release will be sent to the W.M. Keck Foundation for their approval. Once approved, the announcement will be sent to the ACS presidents and deans. A feature article for the fall 2003 issue of the Palladian will be prepared and submitted to the Foundation for approval. And a draft template acknowledgement statement that will be used on all ACS science initiative web pages, workshop agendas, printed materials related to this initiative and in public presentations also will be submitted for approval.

### **Conclusion**

Given the impact of science on everyday life, it is imperative to address the issue of science literacy. It is important that our students are able to:

- understand and appreciate the scientific world-view, including its limitations, and how it differs from other perspectives,
- understand the increase of inter-relationships among the different disciplines of science,
- understand the connection between scientific concepts and technological developments, their impact on society, and the cultural and historical context in which they emerge, and
- use their understanding to evaluate rationally scientific controversies in the world.

The ACS is convinced that the pursuit of these goals by focusing on science courses for non-majors will be exciting, challenging, and extremely valuable. Because of the consortium's history of successful collaboration and its preliminary activities in the area of science education reform, the ACS is poised to make a significant contribution to its member institutions, to American higher education, and to society in general. Consequently, it is our hope that the W.M. Keck Foundation will enable the consortium to implement its plans.

## PROPOSED BUDGET & PROJECTED TIMELINE

This projected budget assumes that grant funds will be received in mid-to late summer of 2003. A one page, Budget and Timeline Summary Table is available in Appendix B.

### Year One- Academic Year 2003-2004

<p>Course Implementation - Fall and Spring terms Includes quality assessment, materials, faculty reassigned time, ACS and non-ACS consulting assistance.</p> <p>Implementation of 2 new courses @ \$5,000 each Review and Redesign of 2 pilot courses @ \$10,000 each Design 2 new courses @ \$20,000 each</p>	<p>\$ 70,000</p>
<p>New Science Faculty Orientation, Training, Mentoring Rotating, on campus seminars for new faculty development. New faculty defined as those in the first three-five years of their teaching career. ACS and non-ACS leadership/consultant expenses, materials, participant and leader travel, room/board</p>	<p>9,000</p>
<p>Course Design and Assessment Workshop - Fall 2003 20 participants, each @\$500 travel, \$300 Room/Board ACS and non-ACS leadership/consultants @ \$3,500 materials @ \$2,500</p>	<p>22,000</p>
<p>Information Exchange Workshop- End of the academic year 20 participants each @ \$500 travel; \$300 room/board; ACS and non-ACS leadership/consultants @\$3,500; materials @ \$2,500</p>	<p>22,000</p>
<p>Dissemination Presentations at professional associations, conferences and special workshops, publications, electronic communication, and possible implementation of the Circuit Rider Program on a small scale</p>	<p>6,000</p>
<p>Program Committee Meetings 1-2 on-site meetings, 14-16 committee members, travel, room/board, materials</p>	<p>11,000</p>
<p>Office Expenses E.g., phone, fax, paper, postage, equipment, paper and electronic resources</p>	<p>16,000</p>
<p>ACS Staff/Consultants Stipends for staff/consultant support</p>	<p>15,000</p>
<p>ACS Staff Travel 1-2 staff travel, room/board to visit campuses, attend Program Committee meetings and related professional meetings to make Presentations, and attend all other project functions</p>	<p>8,000</p>

(Sub-total Year One - \$179,000)

**Year Two - Academic Year 2004-2005**

Course Implementation	90,000
Same purpose as Year I	
Implement 2 new courses @ \$5,000 each	
Review and redesign 2 courses @ \$10,000 each	
Design 3 new courses @ \$20,000 each	
Course Implementation Workshop	22,000
20 participants each @ \$500 travel; \$300 room/board;	
ACS and non-ACS leadership/consultants @ \$3,500;	
materials @ \$2,500	
Assessment of Courses	7,000
Workshops, seminars, faculty release time,	
Leadership/consultant expenses, travel, room/board,	
materials	
New Science faculty development, training, mentoring	9,000
Rotating, on-campus seminars; ACS and non-ACS	
leadership expenses, materials, travel, room/board,	
materials	
Dissemination	6,000
Presentations at professional associations, conferences and	
special workshops, publications, electronic communications,	
and expansion of the Circuit Rider program	
Program Committee Meetings	11,000
1-2 on-site meetings, 14-16 committee members, travel,	
room/board, materials	
Office Expenses	16,000
E.g., phone, fax, paper, copying, postage, equipment,	
electronic and paper resources	
ACS Staff/Consultants	15,000
Stipends for staff/consultant support	
ACS Staff Travel	8,000
1-2 staff travel, room/board to visit campuses, attend workshop and	
Program Committee meetings.	

*(Sub-Total Year Two - \$184,000)*

**Year Three - Academic Year 2005-2006**

Course Implementation	65,000
Implement 3 new courses @ \$5,000 each	
Review and redesign 1 course @ \$10,000 each	
Design 2 new courses @ \$20,000 each	
Assessment of Courses and Assessment of Grant program	7,000
Workshops, seminars; faculty release time, materials,	
ACS and non-ACS leadership/consultant expenses,	
Travel, room/board	
Science faculty development, training, mentoring	9,000
Rotating, on-campus seminars, ACS and non-ACS	
leadership/consultant expenses, travel, room/board,	
materials	
Dissemination	6,000
Presentations at professional association, conferences,	
and special workshops, publications, electronic communication	
and use of Circuit Rider Program	
Program Committee Meetings	11,000
1-2 on-site meetings, 14-16 committee members, consultant(s),	
travel, room/board, materials	
Office Expenses	16,000
E.g., phone, fax, paper, copying, printing, paper, postage,	
equipment, electronic and paper resources	
ACS Staff/Consultants	15,000
Stipends for staff/consultant support	
ACS Staff Travel	8,000
1-2 staff travel, room/board to visit campuses, attend project	
related functions and Program Committee meetings	

*(Sub Total Year Three - \$137,000)*

***Three year total***

***\$500,000***

**Appendix A**  
**Project Planning History**

**Project Planning History**

1997	Discussion of Non-Majors Science Education by ACS Council of Deans  Steering Committee Established
1998	ACS Workshop on Science Education February 1998, Birmingham-Southern College 11 ACS institutions
1999	First conversation between ACS and the W.M. Keck Foundation  ACS Council of Deans reaffirms interest and intentions  Steering committee reformed
2000-2003	Cycle of developing, implementing, assessing, redesigning pilot courses at individual ACS institutions
2000	ACS Workshop on Non-Majors Science Education June 2000, Trinity University 13 institutions
2001	Exploratory proposal submitted to the W.M. Keck Foundation
2002	Phase I Proposal submitted to the W.M. Keck Foundation, Fall 2002
2003	Phase II Proposal submitted to the W.M. Keck Foundation, March 2003

**Appendix B**

**Budget and Timeline Summary Table**

## Appendix B

**Budget & Timeline Summary Table**

	<b>Year One 2003-2004</b>	<b>Year Two 2004-2005</b>	<b>Year Three 2005-2006</b>	<b>Total</b>
Courses	Implement 2 new Review & redesign 2 Design 2 new <i>\$70,000</i>	Implement 2 new Review & redesign 2 Design 3 new <i>\$90,000</i>	Implement 3 new Review & redesign 1 Design 2 <i>\$65,000</i>	\$ 225,000
Faculty Development	New Science Faculty Orientation, Training, Mentoring <i>\$ 9,000</i>	New Science Faculty Training, Mentoring, Orientation <i>\$ 9,000</i>	Faculty Training, Mentoring <i>\$9,000</i>	\$ 27,000
Workshops Seminars Faculty Stipends Release Time	Course Assessment & Design Info Exchange <i>\$44,000</i>	Course Implementation Course Assessment <i>\$29,000</i>	Course Assessment Fall 05 <i>\$7,000</i>	\$ 80,000
Dissemination	Electronic, Print, Presentations, Circuit Rider Program <i>\$ 6,000</i>	Electronic, Print, Presentations, Circuit Rider Program <i>\$ 6,000</i>	Electronic, Print, Presentations, Circuit Rider Program <i>\$ 6,000</i>	\$ 18,000
Program Committee Meetings	Late Summer/ Early Fall 03 Spring/Summer 04 <i>\$11,000</i>	Fall 04 Spring 05 <i>\$11,000</i>	Fall 05 Spring 06 <i>\$11,000</i>	\$ 33,000
Office Expenses	Phone, fax, paper, postage, equipment, print/electronic resources <i>\$16,000</i>	Phone, fax, paper, postage, equipment, print/electronic resources <i>\$16,000</i>	Phone, fax, paper, postage, equipment, print/electronic resources <i>\$16,000</i>	\$ 48,000
ACS Staff and Consultants	Staff/consultant stipends <i>\$15,000</i>	Staff/consultant stipends <i>\$15,000</i>	Staff/consultant stipends <i>\$15,000</i>	\$ 45,000
ACS Staff Travel	1-2 ACS Staff travel, room/board to visit campuses, attend committee meetings, project functions, and related professional meetings <i>\$ 8,000</i>	1-2 ACS Staff travel, room/board to visit campuses, attend committee meetings, project functions, and related professional meetings <i>\$ 8,000</i>	1-2 ACS Staff travel, room/board to visit campuses, attend committee meetings, project functions, and related professional meetings <i>\$ 8,000</i>	\$ 24,000
<b>Total</b>	<b>\$179,000</b>	<b>\$184,000</b>	<b>\$137,000</b>	<b>\$ 500,000</b>

**Appendix C**

**Sample Submission and Selection Criteria  
For Course Mini-Grants**

**Sample Proposal Cover Sheet**

**Sample Mini-Grant Submission and Selection Criteria  
For Introductory Science Course/Module  
Design, Redesign, Assessment and Implementation**

**General Information**

The Associated Colleges of the South - Introductory Science Courses for Non-Majors Program - invites natural science faculty from all sixteen ACS member institutions to submit proposals for mini-grants made possible by funding from the W.M. Keck Foundation. The purpose of these grants is to encourage the design, evaluation, redesign, and implementation of introductory science courses for non-majors that will address the critical problem of science literacy and fluency among non-science majors, primarily in the disciplines of biology, chemistry, geology, and physics.

I. Projects may be proposed in one or more of the following areas:

- Course Development (e.g., creation of new courses, the preparation of laboratory or other interactive, field-based experiences, modules, or other course materials)
- Evaluation and redesign of an existing course or module
- Implementation of a new or redesigned introductory science course or module
- Collaborative and/or interdisciplinary science courses, modules, or field-based experiences

Whether the proposal addresses a new course, module, or other learning/teaching activity, the resulting experience should increase students' ability to:

- understand and appreciate the scientific world-view, including its limitations, and how it differs from other perspectives,
- understand the increase of inter-relationships among the different disciplines of science,
- understand the connection between scientific concepts and technological developments, their impact on society, and the cultural and historical context in which they emerge, and
- use their understanding to evaluate rationally scientific controversies in the world.

II. Availability of Mini-Grants

The ACS Reform of Science Education for Non-Science Majors Initiative will have mini-grants available in the following three-year funding pattern:

A.	Year One, Academic Year 2003-2004	<b>\$ 70,000</b>
	Implementation of 2 new courses/modules/activities @ \$5,000 each	
	Review and/or redesign of 2 pilot or existing	
	courses/modules/activities @ \$10,000 each	
	Design of 2 new courses/modules/activities @ \$20,000 each	

## Appendix C

B. Year Two, Academic Year 2004-2005	<b>\$ 90,000</b>
Implementation of 2 new courses/modules/activities @ \$ 5,000 each	
Review and/or redesign of 2 courses/modules/activities @ \$10,000 each	
Design of 3 new courses/modules/activities @ \$20,000 each	
C. Year Three, Academic Year 2005-2006	<b>\$ 65,000</b>
Implementation of 3 new courses/modules/activities @ \$5,000 each	
Review and/or redesign of 1 course/module/activity @ \$10,000 each	
Design of 2 new courses/modules, activities @ \$20,000 each	

Mini-Grants may be used for faculty release time, faculty research stipends, and course related resources and/or materials. Funds may not be used for student employment, ????

### III. Acceptance Guidelines

- A. For a proposal to be accepted for consideration, it must:
- directly address introductory science courses for non-majors and the mission, purposes, and objectives of this initiative
  - include a projected budget, detailing how the funds will be used
  - be able to be completed within one term or academic year
  - include the signatures of the department chair and the chief academic officer of the corresponding campus(es)

#### B. Proposal Elements

A completed full proposal consists of a single hard copy and a copy to be submitted via email, and must include the following:

1. Standard Cover Sheet (printable from the ACS web site) that includes
  - Name(s) of faculty submitting the request
  - Title, Department, Institution and mailing address
  - Phone, Fax, and e-mail information
  - Title of Course, module, or other activity
  - Category of submission: new course/module/teaching & learning activity, course assessment, redesign, or course/module/teaching & learning activity implementation
  - Date of submission
  - Signatures of department chair(s) and chief academic officer(s)
2. Introduction
  - Issue, topic, or process addressed by the proposal
  - Goal(s) and objectives of the course/module/activity
  - Description of collaborative relationships, if any
  - Anticipated outcomes and benefits to non-major science students

3. Description
  - Course/module/activity components and implementation
  - Prior activities or research related to proposal
  - Projected timetable
  - Requested budget, with justification
4. Evaluation and Dissemination
  - Description of evaluation process. How will success be measured?
  - Plans for dissemination of results. Include a plan to showcase the results of the project. For example, recipients may be asked to present results at ACS and other conferences and workshops.
5. C.V. of Faculty Participant(s)

Maximum of two pages. If multiple institutions are involved, include a c.v. for the principle faculty and at least one faculty c.v. from each collaborating institution.
6. Disclosure Statement

Each applicant is asked to list other on-going grant activities or activities that will coincide with the submitted proposal. Each applicant is further requested to include current and pending funding information relevant to these activities.

#### C. Final Report

It is expected that a detailed written report will be submitted within 30 days of the end of funding time frame, addressing project activities, outcomes, lessons learned, finances, and any follow-up plans.

#### IV. Proposal Deadlines and Submission Schedule

Proposals will be reviewed by a sub-committee of the Science Education Planning Committee and the designated ACS staff person(s). A timeline for submission and review will be posted on the related ACS web site, published in the Palladian and e-Palladian, and distributed to the member campuses through the Council of Deans.

#### V. Full Proposal Application Submittal

Submit a single hard copy (by mail, UPS, FEDEX, etc.) and an electronic copy in the format previously outlined to:

ACS Science Education Initiative  
Associated Colleges of the South  
1975 Century Blvd., Suite 10  
Atlanta, GA 30345  
Phone: 404-636-9553; FAX: 404-636-9558  
E-mail: [bowser@colleges.org](mailto:bowser@colleges.org)

## VI. Questions

If at any time there is a question related to the preparation of the proposal, please contact your ACS institutional program committee member or the ACS Director of Program Development (bowser@colleges.org).

### **Committee Review Process Guidelines**

While the specific guidelines to be used in the review and selection of proposals will be established by the knowledgeable persons selected to serve as committee members, we recommend the following guidelines be observed to ensure that the review and selection process is fair and unbiased:

- Review committee members who are directly or closely involved in any project or who are members of the same academic department as the faculty submitting the proposal will not rank the proposal in question.
- Campaigning on behalf of any one project by members of the larger planning committee or the review committee is discouraged.
- The designated ACS staff person will coordinate/facilitate the submission and review process.

**Introductory Science Courses for Non-Majors**

**2003-2004 Proposal Cover Sheet**

Institution: \_\_\_\_\_

Faculty Department \_\_\_\_\_

Faculty Name: \_\_\_\_\_

Faculty Address: \_\_\_\_\_

Phone: \_\_\_\_\_ Fax \_\_\_\_\_

e-mail \_\_\_\_\_

Project Title \_\_\_\_\_

Amount requested \_\_\_\_\_

Activity (check all that apply)

- |   |   |
|---|---|
| <input type="checkbox"/> New Course Development       | <input type="checkbox"/> Course Assessment        |
| <input type="checkbox"/> New Module Development       | <input type="checkbox"/> Module Assessment        |
| <input type="checkbox"/> Redesign existing course     | <input type="checkbox"/> Redesign existing module |
| <input type="checkbox"/> Implement Course             | <input type="checkbox"/> Implement Module         |
| <input type="checkbox"/> Other (please explain) _____ |   |

Signature of faculty submitting proposal \_\_\_\_\_

Date \_\_\_\_\_

\_\_\_\_\_  
(Print) name of Department Chair

\_\_\_\_\_  
(Print) Name of Academic Officer

\_\_\_\_\_  
Signature of Department Chair

\_\_\_\_\_  
Title of Academic Officer

\_\_\_\_\_  
Signature of Academic Officer

Date \_\_\_\_\_

Date \_\_\_\_\_

**Appendix D**  
**Examples of Pilot Courses/Modules**  
**and**  
**Course/Module Changes at ACS Institutions**

### **Additional Course Examples from Trinity University San Antonio, Texas**

All students at Trinity University are required to take at least one course from Biology, Chemistry, Geosciences, or Physics. About 500 students each year (more than eighty percent of Trinity students) fulfill this requirement by taking a course with a laboratory. Thus, the lower division courses and labs in Biology, Chemistry, Geosciences, and Physics determine the attitude toward science of a large majority of students at Trinity University.

Since many of the important scientific questions of the future will cross the traditional disciplinary boundaries, Trinity is emphasizing multidisciplinary topics in its introductory science courses. For example, in Physics the capstone projects examine multidisciplinary environmental issues. In Chemistry the capstone projects examine biochemical processes. In Geosciences, techniques and concepts from Physics, Chemistry, and Biology will be included in many laboratory projects. In Biology, the integration of the Biology and Chemistry curricula will permit students to conduct experiments that emphasize the interdependence of these two disciplines and build on their expertise with chemical methods.

#### **Physics**

Physicists do and will continue to work in a world of extraordinarily rapid technological change. Although the specific features of future technology cannot be seen, it is fairly certain that the laws of physics underlying future technology will be the laws known today. Students can best be prepared to understand the technology of tomorrow by helping them construct authentic understanding of these fundamental laws. The Physics Department faculty at Trinity University believes that they can help students achieve this kind of understanding by converting the introductory lab courses to a discovery instruction format, and this conversion already is underway.

To effectively implement the discovery lab format, existing equipment that requires hand entry of data is being replaced with equipment based on sensors designed for computer interface. This improves the discovery learning process in a variety of important ways. Real time computer data acquisition and data analysis shorten the time between experimental procedure and resulting conclusions. Errors become obvious sooner and the experiment can be repeated easily in an improved form. More time will be available for “what-if” questions and for construction of mental models of the results. Students can repeat cycles of prediction and observation more quickly and repeated reframing of an improved research question will become practical.

In addition, “black-box” lab equipment will be replaced with equipment designed to make the principles of operation apparent. For example, traditional spectrometers will be replaced with an apparatus that makes the function of each component evident. Students will be able to see the diffracted light and through direct manipulation will discover the relationship between spectral intensity and the angular position of the photo-sensor. Students will understand the principles of operation of the commercial spectrometers encountered in industry as well as in Biology and Chemistry labs.

Further benefits from the discovery instruction format can be achieved if introductory lab students can successfully address interesting topics in contemporary science. This is possible if

## Trinity - continued

students are prepared for a capstone experience by a series of labs designed to provide the required background. For example, the new topic sequence for Physics 1111 will include the linear oscillator, the nonlinear oscillator and the characteristic behaviors of linear and non-linear systems. This revised course will conclude with a capstone project on deterministic chaos in non-linear systems. In this project students will encounter a fundamental limit to the predictive powers of quantitative models of some non-linear systems and appreciate a corresponding limit with the scientific method.

## Chemistry

Many of the most exciting developments in the chemical sciences lie at the interface between Chemistry and Biology. The curricula in these two disciplines at Trinity University are situated to take advantage of this synergy because of faculty interest in coordinating course content and because of the overlap in the student population in the lower division courses.

The lower division Chemistry curriculum is being modified to enhance this emphasis on the interrelation of Chemistry and Biology. Planned enhancements include the incorporation of biochemistry modules into the general, organic, and inorganic lectures. For example, in the general Chemistry course, the treatment of kinetics will be enhanced by the inclusion of Michaelis Menten kinetics which treat enzyme reactions.

Likewise, biochemical concepts and techniques will be reinforced throughout the laboratory experiences. Typically, the laboratory experience has emphasized student use of sophisticated instrumentation, including methods that have utility in molecular biology. Experiments in the first year have focused on the development of expertise in the areas of spectroscopy (UV/visible, atomic absorption, Fourier transform infrared and nuclear magnetic resonance) as well as pH measurement and chromatography. These experiences will be revised to emphasize basic chemical principles by adding a capstone experiment in which student research teams will utilize the expertise they have developed to solve a problem. In addition, there will be a capstone project that is particularly relevant to the interests of the students, by asking the, to use chemical expertise in a biological setting. For example, an appropriate capstone experience in the first semester lab would require measurement of iron release from ferritin, the major iron-storage protein in living organisms. Students will receive a description of the biological function of ferritin and be challenged to design an experiment to examine iron release as a function of specific chemical triggers. This capstone topic will utilize expertise in UV/visible and atomic absorption spectroscopy and concepts of enzyme kinetics developed earlier in the course. Students will choose how to monitor Fe release and how to test effects of the chemical triggers, pH and reducing agents, or the relative affinity of ferritin for Cu and Zn, either in isolation or in competition with Fe. A new atomic absorption spectrometer will replace the existing aging instrument and allow fast sequential multi-element analysis of Fe, Cu, and Zn.

## Biology

The challenge for introductory Biology laboratories is to create opportunities for students to do their own authentic experiments. Ideally, this authenticity should include (1) student input into the experimental design, (2) an experimental system relevant to current research, (3) instruments that could be used for similar purpose in a research setting, (4) the generation of

## Trinity - continued

realistic data sets that reflect both the complexity and regularity of biological phenomena, and (5) communication in the standard formats of scientific discourse.

Almost without exception, such experiments deal with variables or methods that are chemical or physical in nature. Thoughtful experimental design and analysis requires understanding that crosses the boundaries between the traditional disciplines. As noted in the Chemistry section, Trinity has recognized the opportunities arising because most of their students take introductory Biology and Chemistry at the same time. Faculty members in these departments are beginning to use hands-on experience with instruments and reagents to guide students through principles and methods of Chemistry that are directly relevant to Biology experiments.

The laboratories for the three courses in the introductory Biology sequence provide three different settings for students to experience the process of science and develop a sense of the chemical context of biological systems. The laboratory for the first course “Evolution Diversity and Ecology” (Biology 1118) has been revised to focus exclusively on discovery-based exercises and the process of presenting ideas in the scientific format. The following laboratory, “Organismal Structure and Function” (Biology 1119), introduces chemical methods and concepts as a means to understand organism functions. The instructors have recently begun selective incorporation of student-designed experiments in this course.

The Biology Department has made the most significant strides towards implementing a student-as-investigator laboratory experience in Biology 1118, a course designed principally for students completing their science distribution requirement. Teams of students design laboratory experiments using short life cycle plants (*Brassica rapa*, “Fast Plants”) to test effects of a specific environmental variable. They also develop statistical methodology to evaluate their results. The second project is to develop strategies for assessing inheritance patterns of selected traits in fruit flies. A third exercise uses Systematics software as a medium for performing “experiments” with different data sets to model phylogenetic trees for familiar organisms. When experiments are complete, the “principal investigator” of the group writes up the research as a scientific paper, which then peer-reviewed by other members of the group. The course concludes with a symposium incorporating poster presentations or web pages reporting on research projects. This course has become a model for revisions to the rest of the core laboratory sequence.

For Biology 1118, further revisions are proposed that will extend the range of possible student designed experiments in the “Fast-Plants” exercise by adding a matched pair of small reach-in growth chambers to maintain specific light, temperature and humidity conditions. Although Fast-Plants grown under less-than-controlled laboratory conditions, they respond to variations in environment. The resulting variability in performance frustrates students attempting to draw conclusions from usually are small data sets. The second chamber will open up the possibility of using light, temperature or humidity as the variable to be tested. The fruit fly genetics project also will benefit because the maintenance of consistent conditions will produce consistent generation times. This will limit difficulties with scheduling and the need to repeat crosses because a particular generation matured too soon or too late.

The Departments of Biology, Chemistry, Geosciences, and Physics share a commitment to the development of the student as an active learner and recognize the importance of examining problems from a multidisciplinary perspective. This plan reflects their intent to incorporate these goals into the introductory laboratory courses that impact almost all of the students at Trinity University.

### **Additional Course Examples from Birmingham-Southern College Birmingham, Alabama**

In 2002, Birmingham Southern College also offered two new biology courses. “Cancer: Biology and Beyond” was developed to increase the number of science courses available for non-science majors. Initially offered during BSC’s January 2002 Interim term, this course provided students with the opportunity to study the development, progression, and treatment of cancer. By exploring differences between normal and cancerous cells, students learned the fundamentals of cell biology. Readings from Robert Weinberg’s book *One Renegade Cell* provided a framework for understanding the molecular processes that drive the development, and ultimately the treatment, of cancer. Laboratory exercises complemented material learned from reading assignments and class discussions, while field trips acquainted participants with resources for dealing with the psychological and socioeconomic impact of the disease. Twelve students enrolled in this initial offering of “Cancer: Biology and Beyond,” and the feedback was quite positive. Furthermore, when asked, eleven out of twelve students said they “would recommend this Interim project to another student.” The twelfth student said, “it depends on the student’s interest.” Despite this success, several modifications were made in the course offered during the spring term of 2003. First and foremost, the class will be offered during a traditional term, so students will meet each week throughout the semester for three hours of lecture and three hours of lab, as opposed to meeting a couple of hours each day for a month. To add greater depth to this student of cancer biology, *Scientific American’s* September 1996 issue, “What You Need to Know About Cancer,” will be added to the reading list. After students acquire a sound scientific background, they will critically evaluate the media’s portrayal of cancer and related research. Students also will be more actively encouraged to make intellectual connections between many disciplines. Not only will they learn about the biology of cancer, but they also will discuss the psychological impact of diagnosis, and they will use statistical analyses to critically evaluate how various behaviors impact the likelihood of developing the disease. Finally, in response to student comments, the instructor will incorporate more fieldtrips and opportunities to meet with cancer patients. These revisions will be evaluated at the end of the term, and an updated version of this course will be offered every other spring term.

A revised Biology 103 course is the most recent undergraduate science course for non-majors to debut at BSC. Entitled “Introduction to Forensic Science: Using Science to Solve Crimes,” this course was offered for the first time in the fall of 2002. Designed for first-year students, it introduces non-science majors to the field of criminalistics. The course considers actual criminal cases and how they were solved by use of forensic techniques. In addition, simulated crime scenes are used to provide students with an opportunity to “solve” crimes using forensic science. Three lectures and one three-hour laboratory per week are required throughout the term. The course focuses on the techniques of biology and chemistry used to solve crimes, but also considers such additional topics as document examination, geology, and forensic art. Investigative laboratories focus on techniques in microscopy, serology, entomology, molecular biology, anthropology, and chemistry. The course also considers the legal process in criminal investigations, ethical issues regarding privacy and individual rights, and how forensic science is portrayed in the popular media. The course was well received by the eighteen students who took it, and they offered very complementary comments about the course and gave it very good

## BSC-continued

evaluation numbers on the in-house student evaluation instrument. The instructor indicates that minor revisions will be made in the lecture and the lab portions of the class as he tries to fine tune and make the course run more smoothly. Also, he anticipates that the content will vary slightly from year to year, depending upon the availability of such things as speakers, equipment, funds, and other resources. The course will be offered next in spring 2004. Thereafter, the course will be offered annually, either in the fall or the spring, and will be offered some years as a course open only to first-year students, and in other years any non-science majors (freshman through seniors) may take the course.

### **Course Examples from Furman University Greenville, South Carolina**

Furman University offers a two-course science sequence, Science 16 and 17, for non-majors that can satisfy the University's natural science General Education Requirement. First offered in the 1999-2000 academic year, these multidisciplinary courses have been significantly revised each time they have been taught, in order to make them better.

SC 16 and 17 stress the scientific investigative process through examples from all of the natural science disciplines represented at Furman: Earth and Environmental Science, Chemistry, Physics, and Biology. In SC 16, the classroom part of the course combines a philosophical treatment of science and the process of scientific investigation with the exemplification of these principles through the study of a set of historical examples, such as the discovery of the structure of DNA and the development of the model of plate tectonics. The laboratory component of SC 16 is a series of individual activities that teach specific investigative procedures and skills applicable to many scientific disciplines, including how to ask a good question, how to graphically visualize and interpret data, and how to deal with errors in measurement.

In SC 17 the classroom component continues the discussion begun in SC 16 to include analysis of scientific episodes in which the conclusions are more tentative. These include such topics as global warming and the future of the universe. The laboratory component of this second course encourages the student to use skills learned in the first course to design and carry out small group investigations of specific phenomena.

In any given academic year, both courses are taught by a pair of professors from two of the four natural science departments. These professors are present simultaneously each day, which provides students with the opportunity to experience interdisciplinary dialogue, helps them appreciate how different disciplines approach problems, and how many scientific questions require expertise across artificial disciplinary boundaries.

### **Course Examples from Centre College Danville, Kentucky**

At Centre College all students take an integrated humanities course sequence during their freshman year. In 1998 Centre College began implementation of a two course general education sequence in the natural sciences, which usually is taken by sophomores and can build upon a student's common background in the classical period and early Greek philosophy as well as the additional year of intellectual maturity. These natural science courses primarily are an introductory survey of science, with an emphasis upon how scientific understandings have developed and the bases upon which current explanations depends. The courses present a science-based world view that traces the continuity of natural processes in cosmology and in the physical and biological evolution of our planet. Content is built upon a general, chronological framework, including such topics as motion, astronomy, energy, the structure of matter, the origin of the world, evolution, biological diversity of life, regulation of life, and the human position in the world. The selected topics support a solid understanding of the major areas of cosmological and biological evolution.

The primary goals of the two course sequence of general education natural science courses are for students to:

- develop an appreciation of the natural world.
- gain an understanding of the scientific world view and how it differs from other ways of perceiving the world.

Because of the ease with which connections can be made between areas of inquiry, the integrated approach helps students build connections between knowledge and facilitates accomplishing these goals.

If the ACS receives a grant from the W.M. Keck Foundation, Centre College will apply for mini-grant support to conduct a thorough evaluation of the two course natural science sequence to determine the extent to which the goals are being achieved, the students' perceptions of both the material and the pedagogical approaches, and to identify improved practices, as well as practices for improvement.

## Course Examples from the University of Richmond Richmond, Virginia

### The Chemistry Department

In the Spring of 2003, Chemistry 112, “Biochemistry in the Real World,” was offered for the first time, with 32 students enrolled. This is a general education course that provides students with an opportunity to explore the world of biochemistry and molecular biology from the perspective of issues that impact our daily lives. Topics, including diseases such as AIDS, Alzheimer’s, genetic engineering, and drug design are chosen to allow students to appreciate some of the fundamentals of chemistry and biology, and the related ethical issues, in the content of current issues and problems facing society. Laboratory sessions include investigations designed to illustrate the nature of the scientific method and to provide hands-on experience with the techniques that are used to study the structure and function of biologically significant molecules and processes. This course will be offered once or twice during an academic year.

In the fall of 2002, Richmond unveiled the revised introductory Chemistry 141 course. Called “Introductory Chemistry: Structure, Dynamics, and Synthesis,” this course and the required laboratory sessions explore the fundamental principles of chemistry, including such topics as energy relationships, atomic structure, theories of bonding, chemical reactions and equilibria, separations, and structure-property relationships. A conscious effort is made to relate the abstract principles under discussion to developing disciplines and topics of current and historical interest. This course will be offered twice during each academic year. To date, 159 students have taken the course since its first offering.

In the spring of 2002, 39 students enrolled in Richmond’s redesigned Chemistry 110 course, which was first offered in 1994. The original title of “Atoms, Molecules, Humans, Change” was changed to “Pollutants in the Environment.” In this redesigned, one-semester laboratory based course, students explore chemical principles in the context of technological and societal issues with an environmental theme, such as global warming, water quality, energy sources, and waste management. As issues are discussed, key chemical concepts are taught on a need-to-know basis. The laboratory component meets for three hours each week, and the majority of the experiments are problem solving and discovery based. This redesigned course will be offered twice per academic year.

### The Biology Department

“Microbiology: Unseen Life” (Biology 106) was first offered at the University of Richmond in the Spring of 2002, with 30 enrolled students. This course provides the general education student an opportunity to explore the world of microbiology and the many ways that microbes impact daily life. Topics include an introduction to the diversity of microbial life and reviews of microbes that are significant in agriculture, medicine, and the food industry. Laboratory sessions include investigations designed to illustrate the nature of the scientific

## Richmond - continued

methods and hands-on experiences with the techniques that are used to study and to identify microorganisms. The course will be offered once per academic year.

Biology 107, "Human Genetics," examines genetics and heredity in the specific context of human beings and ranges from the classical principles elucidated by Mendel to modern DNA technology. Throughout the course, impact of genetics on modern day life, public policy, and the law is emphasized. Topics such as genetic disease, prenatal testing, gene therapy, recombinant DNA technology, and DNA-based forensics illustrate the complex interplay between science, society, and the individual. Lectures, discussions, experiments, and debates help to hone students' critical and scientific thinking and informed skepticism. First offered in 1998, 52 students have enrolled in this course that is offered once per academic year.

"Environmental Biology" (Biology 108) was first offered in the fall of 2000. Topics include basic ecological principles and selected topics in environmental science, such as human population growth, patterns of energy and resource consumption, water quality, food production, and resource management. Emphasis is on the application of the scientific method in the study of ecology and the environment. Course components include classroom, field, and laboratory activities. Offered twice in each academic year, which includes the May term, approximately 263 students have enrolled to date.

"Introduction to Genetics" (Biology 201) was first introduced in the fall of 2002. This is a one semester course with a required laboratory, offered once per academic year that enables students to understand the basic processes of gene transmission and mutation and to become familiar with the principal experimental methods used by geneticists and molecular biologists. The fundamental goal of the course is to help students develop the ability to think like a geneticist and formulate genetic hypotheses, work out their consequences, and test the results. Ethical and social topics within the context of genetics also are presented and discussed, such as a prenatal diagnosis, identification of genetic risk factors for complex traits, and the human genome project. To date, 225 students have enrolled in this course that is offered once per academic year.

## Department of Physics

"Elements of Physics" (Physics 125) first was introduced in the fall of 1998. Offered once per academic year, some 370 students have enrolled in this course in the last four years. Using the inquiry-based, integrated laboratory/lecture format, students study the principles and applications of physics, focusing on topics selected from mechanics, sound, light, electricity, magnetism, heat, and modern physics.

**Appendix E**

**The Seven Principles for Good Practice in Undergraduate Education**

**And**

**Key Elements of Course Design and Planning**

**For Application in the ACS Science Initiative for Non-Majors**

### **The Seven Principles for Good Practice in Undergraduate Education For Application in the ACS Science Initiative for Non-Majors**

The Seven Principles for Good Practice in Undergraduate Education offers a succinct and an easy-to-remember phrasing of findings from decades of research on the undergraduate experience. Arthur W. Chickering and Zelda F. Gamson first published the Seven Principles for Good Practice in Undergraduate Education in 1987, in a book with the same title. While these seven principles are not new, indeed some 350 years ago Comenius called for active learning, what is “new” is the growing body of research that substantiates the importance of these principles and their presentation format.

Chickering and Gamson’s seven principles are based on a view that understands education to be active, cooperative, and demanding and asserts that good practice in undergraduate education:

1. encourages student-faculty contact. Frequent student-faculty contact, in and out of classes, has been identified as the most important factor in student motivation and involvement. Faculty concern helps students to get through rough times and to keep on working. Knowing a few faculty members well enhances students’ intellectual commitment and encourages them to think about their own values and future plans.
2. encourages cooperation among students. Research indicates that student learning is enhanced when it is more like a team effort than it is when pursued solo. Good learning is collaborative and social rather than competitive and isolated. Cooperation and collaboration with others increases involvement in the learning process, and the sharing of one’s own ideas and learning to respond to variety of different ideas and reactions serves to improve thinking and to deepen thinking. Further more, today’s business climate affirms the qualities of cooperation, collaboration, the ability to express one’s ideas and respond appropriately to the ideas of others as highly desirable employee qualities.
3. encourages active learning. As has been said, “learning is not a spectator sport!” Sitting in classes listening to lectures, memorizing pre-packaged assignments, and supplying the “correct” answers does very little for in-depth and real learning. . Learning is really learning when the information is integrated into and becomes part of the learner. In order to achieve this, students must wrestle with ideas, talk and write about what they are learning, relate information and ideas to past experiences, and apply it to their present day lives.
4. gives prompt feedback. Those who are trying to learn something do not come to the learning experience already knowing all they need to know! Lasting benefit is derived from courses when students receive appropriate feedback on their performance. It is important to provide students with frequent opportunities to test their understanding and skills and to receive suggestions for improvement. Opportunities for students to reflect on what they have learned, what they still need to know, and how to assess themselves also are important as points of learning and of feedback.

5. emphasizes time on task. Learning takes time, and effective time management skills is critical for students and professionals alike. Allocating realistic amounts of time means more effective learning for students and more effective teaching for faculty. The basis for high performance for students, faculty, and all levels of staff is determined by how an institution defines time expectations for each of these constituents.

6. communicates high expectations. The saying goes, “expect more and you will get it.” Expecting students to perform well becomes a self-fulfilling prophecy when teachers and institutions hold high expectations of themselves and make extra efforts. The poorly prepared, those unwilling to exert themselves, and the bright and well motivated all benefit from high expectations.

7. respects diverse talents and ways of learning. Much has been written about the various learning styles that have been identified. Regardless of which learning style theory one subscribes to, they all support the basic supposition that people bring different talents and styles of learning to the higher education experience. The student who is brilliant in a seminar may be all thumbs in a laboratory setting. A student who excels in hands-on experiences may not do well in manipulating theories. What is important here is to provide students with opportunities to show their talents and learn in ways that work for them while exposing them to and encouraging to experiment with ways that do not come so easily.

A caveat is in order. The broader agenda behind these principles is the desire to help faculty improve the quality of the teaching/learning environment, and there are many means available to reach this goal. The Seven Principles as defined by Chickering and Gamson (1987) provide one beginning point for conversations designed to encourage faculty to identify the implications of their “favorite” guiding principles and then develop practical classroom applications to fit the students, the discipline, and the particular courses.

**The Design and Planning of Introductory College Courses  
Synopsis of Key Elements  
For Application in the ACS Science Initiative for Non-Majors**

The following definitions provide a basic framework for course design and planning:

A. Curriculum is the academic plan that is constructed (purposefully) to facilitate student learning and progression through the higher education experience to earn an undergraduate degree. While academic plans may be constructed at several levels (i.e., lesson, course program, college), the focus at this level is the individual course plan, which typically is developed by a single faculty member. Course plans are the basic building blocks of the higher education curriculum.

B. College course design and planning is the decision making process in which instructors determine content to be taught, consider various factors affecting the teaching/learning process, and select from multiple methodologies and strategies those to be used to engage students with the content. Design and planning also includes selecting methods and strategies to assess student learning so that the course may be improved for future offerings.

What follows is a synopsis of the key elements usually considered when undertaking the task of designing and planning introductory courses. While there may be slight variations according to the discipline involved, the following elements and steps usually are considered to be basic considerations.

**Identify Influences on Course Design and Planning**

- Contextual, situational (“filters” through which those involved view the need and outcomes)
- Static and/or subject to change
- Departmental/institutional mission, expectations, norms, funding
- Academic Field orientation(s)
- Faculty orientation and competency (scholarly and pedagogical background; beliefs about the purpose of education and other educational “assumptions”)
- External/secular expectations
- Student expectations
- Other factors to be considered

**Determine the audience and characteristics**

- Age range (traditional and/or non-traditional students)
- Status: commuter/resident
- Classification (first year or upper class)
- Emotional, physical, mental, and social characteristics
- Range of learning styles

## Key Elements - continued

### **Course Goals, Objectives, End Results**

- **Goals** - How does the introductory course fit into the departmental and institutional educational plans? What are the long-term goals that may not be totally achievable in one course? What do you want to happen in the course? Are the goals consistent with the reason you (the faculty member) want to teach the course? What would be the learner's goal(s) in taking the class?
- **Objectives** - These should be measurable (quantifiable) and time-delineated. What are the specific learnings and skills to be introduced and developed in this course?
- **End Results** - Where do you want your students to be at the end of the course compared to where they were at the beginning?

### **Amount of Material**

- How much material can realistically be covered in the course?
- What material is essential for the students to know?
- What material is important for the students to know?
- What material is nice for the students to know?

### **Slant or Approach**

- Course goals will in part determine the slant/approach of the course
- Eight basic, possible ways to approach a course (or use a combination of):
  1. *Basics*. A simple introductory course for students with little or no knowledge about the subject.
  2. *Advanced*. New items that students with a basic knowledge are unlikely to know.
  3. *Subtopics*. Taking one particular area within the subject matter and concentrating or specializing on this.
  4. *Demonstration*. Showing class members, or have class members show, how something is done or how something works.
  5. *Practical, how-to*. Emphasizing the mechanics of the topic.
  6. *They do it*. Students actually learn by doing and come away with an ability they didn't have before.
  7. *Current*. Focusing on the latest changes and/or trends in the subject area.
  8. *Relating*. Relate this topic to another topic, current event, or problem.

### **Text and Resources**

- Identifying suitable texts and materials .
- Choosing materials that are appropriate for the intended students and support the objectives, goals, and approach(es).

### **Content Organization and Methodologies**

- What are the best ways to organize and deliver the material?
- Minimum of four organizational possibilities:
  1. Simple to complex. Begin with the easily understood and move to the more difficult.

## Key Elements - continued

2. General to specific. Begin with an overall scheme/theme. Then move to specific items within the overall picture. Move from the large picture to the components of the picture.
  3. Concrete to abstract. Begin with the here and now, and move to theories or concepts.
  4. Chronological/historical sequence.
- Each class session is like a short story; it should have a beginning, a middle, and an end. The student should take something away from every class.
  - Objectives for each class/lab session. What do you want to happen in each class/lab session? What concept, understanding, and/or skill do you want the students to take away from the class? Objectives should be determined before strategies are chosen.
  - What methods/strategies will be used in each class session to introduce concepts and assist students in reaching the objective(s)? What methods/strategies will best support the diverse student population that will be taking the class? Addressing this question requires dividing the content into class/lab sessions, identifying the objective for each session, and determining the teaching/learning method or strategy that will be used to engage the students with the material and with each other.
  - The need for flexibility and willingness to change methodologies and strategies if they are not working.

## Assessment/Evaluation

- Assessment/evaluation occurs at different times and for different reasons. Identify as many possibilities as you can.
- Assessment/evaluation occurs on multiple levels: students, instructor, course, materials, methodologies/strategies, departmental, other.
- The How is determined by What you want to measure (cognitive domain, affective domain, psychomotor skills), Where you want to measure it (natural or artificial conditions), Why you want to measure it (rank compared with others or meets an objective standard), and When you want to measure it (during class for formative or in-progress evaluation or at the end of class for summative evaluation).
- Determine what student learnings and skills you want to assess at the beginning of the course, during the course, and at the end of the course, and create a schedule for such.
- Decide when and how you will assess student learnings and skills and the accomplishment of stated goals and objectives. Are there departmental and/or institutional evaluations and processes that must be considered (and when)?
- Determine how you will evaluate the course materials, format, syllabus, methodologies/strategies, and the course overall. What departmental requirements must be taken into consideration?
- Strive for assessment/evaluative procedures that are valid, reliable, objective, and practical.

**Appendix F**  
**Curriculum Vitas**

**Curriculum Vita**

**Edward C. Roy, Jr.**  
**Gertrude and Walter Pyron Distinguished Professor of Geology**  
**Trinity University**  
**San Antonio, Texas**

Edward C. Roy, Jr. received his B.S. and Ph.D. degrees in geology from Ohio State University 1961 and 1964. Upon graduation, he worked for the Shell Oil Company on the Gulf Coast until 1966, when he became an Assistant Professor of Geology at Trinity University in San Antonio, Texas. He served as the Dean of the Division of Sciences, Mathematics, and Engineering in 1986-87, and as Vice President for Academic Affairs from 1987-1999. He is currently the Gertrude and Walter Pyron Distinguished Professor of Geology.

He is a member of American Association for the Advancement of Science (Fellow), the American Association of Petroleum Geologists (Honorary), SEPM, Geological Society of America (Fellow), Paleontological Society, and the South Texas Geological Society (Honorary).

Roy's research interests are paleontology, paleoecology, biostratigraphy and sedimentology. His publications are devoted to the paleoecology and sedimentology of Mesozoic and Cenozoic rocks. He has served as the President of the American Geological Institute, the Gulf Coast Association of Geological Societies, and of the South Texas Geological Society. For many years he has held memberships on numerous committees of the AAPG, SEPM, GCAGS, and AGI. In addition to his work with professional societies, Roy was a member of the Board of Earth Sciences and Resources of the National Research Council (1993-1998).

Honors and awards include Outstanding Professor (Trinity University, 1967), the Best Paper Award (Gulf Coast Association of Geological Societies, 1981), the A.I. Levorsen Award (Gulf Coast Association of Geological Societies, 1981), the Distinguished Service Award (American Association of Petroleum Geologists, 1990), Honorary Member American Association of Petroleum Geologists, (1993), Fellow American Association for the Advancement of Science (1999), Fellow Geological Society of America.

**SELECTED TRINITY UNIVERSITY COMMITTEE SERVICE**

Athletic Council	1969-72
Faculty Club Committee	1969-72
President	1970-71
Faculty Research & Development Council	1971-72
Teaching & Research Faculty Commission	1972-74
Chairman	1972-73
Admissions Council	1974-77
Ad Hoc Committee on Advising, Spring	1975
Self-Study Task Force – Library	1975-76
Chairman of Selection Committee for Asst/Assoc. Registrar, Spring	1976

## Ed Roy - continued

Board of Editors, Trinity Press	1976-79
Ad Hoc Committee on Academic Reorganization	1980
Distinguished Professorship Committee	1980-81
Standards Committee	1979-84
University Committee on Promotion & Tenure	1981-82
University Curriculum Council	1978-82, 1985-95
Division Advisory Council	1978-84, 1985-87
Piper Professorship Nominating Committee	1982-84; 2001-02
Faculty/Staff Division Committee for Capital Campaign, Chair	1982-84
Search Committee for Director of Personnel	1985
Self-Study Subcommittee for University Advancement, Chair	1985-86
Fringe Benefits Committee	1986-98
Common Curriculum Committee	1986-87

SELECTED CIVIC SERVICE

- Board of Directors, Alamo Regional Science Fair, 1968-78; Fair Director 1969; President, 1973
- 1979 International Science & Engineering Fair Coordinating Committee, 1975-79
- Candidate Selection Committee, Good Government League, 1975
- Lectures in Trinity University Science Lecture Series
- Numerous lectures to civic, professional, and educational groups in the San Antonio area
- Chairman; Fair Operations, International Science & Engineering Fair, 1979 (San Antonio)
- Conducted short courses for Trinity University: Continuing Education: Fundamentals of Petroleum Geology: 1980 through 1985
- Baumberger Endowment Scholarship Selection Committee, 1979 to present
- San Antonio Chamber of Commerce Environment Committee, 1987 to 1991
- Citizens' Advisory Panel, San Antonio Water System, 2002 –
- Earth Science Taskforce, Texas Education Agency (Chair) 2002 -

SELECTED PROFESSIONAL SOCIETY SERVICE

- Technical Program Chairman, Society of Economic Paleontologists & Mineralogists Annual Convention, 1974
- Member of Convention Policy Committee of the Society of Economic Paleontologists & Mineralogists, 1973-75; Convention Policy Committee – Chairman, S.E.P.M., 1975-78
- Associate Editor, American Association of Petroleum Geologists, 1974-82
- South Texas Geological Society: Treasurer, 1975-76; Vice President, 1976-77; President, 1977-78
- Member, Publications Committee, American Association of Petroleum Geologists, 1978-83
- Gulf Coast Association of Geological Societies: Vice President/President-Elect, 1977-78; President, 1978-79

## Ed Roy - continued

- Gulf Coast Association of Geological Societies Financial Aid to Students Committee, Chairman, 1981-85; Member, Gulf Coast Association of Geological Societies Finance Committee, 1980-83; Member, Publications Committee, Gulf Coast Association of Geological Societies, 1981-
- General Chairman, Annual Meeting of the American Association of Petroleum Geologists and its Divisions, San Antonio, 1984
- Chairman, Long range Planning Committee, Gulf Coast Association of Geological Societies, 1985-1991; Technical Program Co-chairman, Gulf Coast Association of Geological Societies Annual Meeting, 1987
- Member, Education Advisory Committee, American Geological Institute, 1985-1988; (Chair 1999 – 2004)
- Member, Academic Liaison Committee, American Association of Petroleum Geologists, 1985-1988; 1990-96, 2002-05; Advisory Board, Treatise of Petroleum Geology, American Association of Petroleum Geologists, 1986-94
- American Geological Institute, Secretary, 1988-90
- Board of Directors, National Conference on Undergraduate Research, 1988-1990
- Member, American Association of Petroleum Geologists, Twenty-First Century Committee, 1990-1991
- Representative of American Association of Petroleum Geologists to the AAAS Section on Geology and Geography, 1991-1997
- National Academy of Sciences, National Research Council, Board on Earth Science and Resources, Member 1993-98, (Executive Committee, 1994-98)
- SEPM Representative to American Geological Institute Member Society Council, 1994-1995
- American Geological Institute, President-Elect (1995-96), President (1996-97)
- National Academy of Sciences, National Research Council, Committee on Women in Science and Engineering, 1995-1997
- General Chairman, Annual Meeting of American Association of Petroleum Geologists and its Divisions, San Antonio, 1999
- Trustee, American Geological Institute Foundation (1998- ) (Secretary 1999- )
- Representative to AAAS Section E, Geology and Geography (2001-2004)

SELECTED PUBLICATIONS

- 1980 - Depositional Systems, An Introduction: in Depositional systems of the Gulf Coast, Readings in Gulf Coast Geology, Vol. 1, 179 p. (compiled by E.C. Roy, Jr.).
- 1981 - A late Cretaceous Calcareenite Beach Complex Associated with Submarine Volcanism, Wilson County, Texas (co-authors) Mark Eidelbach & Nancy Trumbly, Gulf Coast Association Geological Societies, Trans., Vol. 32, pp. 173-178.
- 1983 - Deposition of the Austin Group (upper Cretaceous) associated with Submarine Volcanism, (abs) South Central Section, Geol. Soc. American Abstracts with Programs, Vol. 15, No. 1, p. 40.

## Ed Roy - continued

- 1984 - Stratigraphy & Sedimentology of the Kincaid Formation Midway Group (Paleocene), Upper Rio Grande Embayment, Texas; Trans. Gulf Coast Association Geological Societies, Vol. 34, pp. 211-216; Bulletin American Association Petroleum Geologists (abs), Vol. 68, No. 9, pp. 1218-1219.
- 1984 - An introduction to Holocene Sediments of the Gulf of Mexico, Readings in Gulf Coast Geologists, Gulf Coast Association of Geological Societies, Vol. 5, pp. 1-3.
- 1984 - Holocene Sediments of the Gulf of Mexico, Readings in Gulf Coast Geology, Gulf Coast Association of Geological Societies, Vol. 5, 200 p. (compiled by E.C. Roy, Jr.
- 1986 - A Summary of the Mesozoic Geology of South Central Texas; The Compass, Vol. 63, No. 4, pp. 145-153.
- 1993 - Reform in College-Level Geoscience Education; Journal of Geology Education, V. 41, pp. 312-314.
- 1995 - Earth-Science Education and Employment; *Geotimes*, V.40, No. 4, p. 15.
- 2001 - Report of the Workshop: Earth Systems Science Curriculum, with R. Busch, C. Keane, D. Merritts, 8pp., American Geological Institute.
- 2001 - (No) Earth Science in Texas, *Geotimes*, p.5, Vol. 46, no. 9, American Geological Institute.
- 2001 - Challenges for Undergraduate Education (abs), AGI Associates Conference; Evaluating the Value of Field Experience in Geoscience Training and Education, AGI Website:<[agiweb.org/associates/conference/2001](http://agiweb.org/associates/conference/2001)>
- 2002 - Earth Science in Texas: A Progress Report, *Geotimes*, vol. 47, no. 9, pp 24-25, American Geological Institute.
- 2002 - Earth Science in the Texas K-12 Curriculum (abs), with D. Dunn, Geol. Soc. Of Am., Abstracts with Programs 2002, vol. 34, no. 6, p.74.

**CURRICULUM VITA**

Name: **Leo Pezzementi**  
 Birth: 9 October 1954  
 Position: Professor of Biology; Chair, Division of Science and Mathematics  
 Address: Division of Science and Mathematics, Birmingham-Southern College  
 Box 549022, 900 Arkadelphia Road, Birmingham, Alabama 35254  
 Phone: 205-226-4806/4870  
 Fax: 205-226-3078  
 E-mail: lpezzeme@bsc.edu  
<http://panther.bsc.edu/~lepezzem/>

**EDUCATION**

State University of New York at Stony Brook, Molecular Biology Program and Pharmacological Sciences Program. Dept. of Biochemistry. Ph.D. awarded August 1982.  
 La Salle College, Philadelphia, PA. Biology major. B.A. awarded May 1975.

**PROFESSIONAL EXPERIENCE**

University of California at San Diego School of Medicine, La Jolla, California. Visiting scholar (January 2003-August 2003). Laboratory of Dr. Palmer Taylor, Department of Pharmacology.  
 Ecole Normale Supérieure, Laboratoire de Neurobiologie, Paris, France. Invited professor (June 1992-August 1992). Sabbatical year (July 1990-July 1991). Laboratory of Dr. Jean Massoulié.  
 Case-Western Reserve University School of Medicine, Cleveland, OH. Visiting Scientist (June 1988-August 1988). Laboratory of Dr. Terrone Rosenberry, Department of Pharmacology.  
 University of Alabama at Birmingham, University of Alabama School of Medicine, Birmingham, AL. Adjunct Assistant Professor of Psychiatry (1988-present).  
 Birmingham-Southern College, Birmingham, AL. Chair, Division of Science and Mathematics (1997-2001) Professor of Biology (1996-present). Associate Professor of Biology (1988-1996). Assistant Professor of Biology (1985-1988).  
 Oberlin College, Oberlin, OH. Visiting Assistant Professor of Biology (1983, 1984-1985) and Chemistry (1984).  
 Franklin and Marshall College, Lancaster, PA. Visiting Assistant Professor of Biology (1982-1983).

**RESEARCH INTERESTS**

Cellular and molecular neurobiology of cholinergic systems. Currently my laboratory is using biochemical, pharmacological, and molecular biological approaches to investigate the structure and function of the cholinesterases, ChE1 and ChE2, in amphioxus.

Leo Pezzementi -continued

### **GRANT SUPPORT**

- National Science Foundation Course, Curriculum, and Laboratory Improvement Grant. "A Collaborative Recombinant DNA Technology Course with Laboratory." \$20,383. Grant No. DUE-9950225. (August 1999-July 2001).
- National Science Foundation Research at Undergraduate Institutions Grant. "Evolution of Cholinesterase *In Vivo* and *In Vitro*." \$111,684. Grant No. IBN-9319354. (May 1994-April 1998).
- National Science Foundation Research at Undergraduate Institutions Grant. "Evolution of Acetylcholinesterase." \$124,357. Grant No. BNS-9010710. (Sept. 1990-February 1994).
- National Institutes of Health -- Centre National de la Recherche Scientifique Fellowship. Laboratory of Dr. Jean Massoulié, Laboratoire de Neurobiologie, Ecole Normale Supérieure. 120,000FF. (July 1990-June 1991).
- National Institutes of Health Academic Research Enhancement Award. "Characterization of Lamprey Acetylcholinesterase." \$47,559. Award No. 1 R15 NS24943-01 (August 1987-August 1990).
- National Science Foundation College Science Instrumentation Program. "Equipment for a Modern Undergraduate Cell Biology Laboratory." \$22,046. Award No. CSI-8750089. (July 1987-December 1989).
- Research Corporation Cottrell College Science Grant. "Characterization of Molecular Forms of Acetylcholinesterase from Skeletal Muscle of Lamprey." \$8,000. (December 1984-October 1988).

### **SELECTED PROFESSIONAL RESPONSIBILITIES, HONORS, ORGANIZATIONS**

- Biology Councilor, Council on Undergraduate Research (1989-1992), member (1988-present), editor of *Research in Biology at Primarily Undergraduate Institutions*, 3rd edition (1993-1995), institutional liaison (1994-present).
- American Society for Biochemistry and Molecular Biology (2001-present), Society for Neuroscience (1982-1989, 1992-2002).
- Reviewer, NSF, Instrumentation and Laboratory Improvement, Research at Undergraduate Institutions, and Beginning Investigator Programs; NIH, Academic Research Enhancement Award; ORAU NSF Fellowships.
- NIH Predoctoral Traineeship in Pharmacology (1977-1980).

### **SELECTED CAMPUS RESPONSIBILITIES**

- Co-Chair, Science Building Planning Committee (1998-2002). Construction of the \$25 million Elton B. Stephens Science Center was completed May 2002.
- Chair, General Education Committee (1997-1998), led development of "The Expanded Paradigm of General Education."
- Chair, Division of Science and Mathematics (1997-2001).

Leo Pezzementi - continued

Chair, Faculty Advisory Committee (1993-1994), led development of "Recommendations to Improve Faculty Morale"; elected member (1992-1994, 1995-1996).  
Faculty Development Committee, elected member (1989-1990).  
Faculty Committee on Promotion and Tenure, elected member (2001-2002).  
Curriculum Construction Committee, member (1999-2000); participated in development of "Foundations," the new general education program of the College.  
Faculty Advisor, Tri-Beta Biological Honor Society (1987-1990; 1991-1994).  
Radiation Safety Officer (1987-present), obtained radioisotope license for Biology Department.  
Research Integrity Officer (1995-present), helped establish guidelines for investigation of scientific fraud.

### **SELECTED PUBLICATIONS (undergraduate students are underlined)**

- Leo Pezzementi, Kim Johnson, Justin Cotney, Andrew Barker, Elizabeth Manning, and Sarah Merritt. 2003. Amino acids defining the acyl pocket of an invertebrate cholinesterase, submitted.
- Leo Pezzementi, Kim Johnson, Justin Cotney, Andrew Barker, and Elizabeth Manning. 2003. Amino acids involved in substrate and inhibitor specificity in cholinesterase 2 from amphioxus. *Biological Research*, in press.
- Leo Pezzementi and Joy F. Johnson. 2002. A collaborative, investigative recombinant DNA technology course with laboratory. **Biochemistry and Molecular Biology Education**, 30, 376-379.
- James Scott McClellan, William Blake Coblenz, Mathew Sapp, Gabriel Rulewicz, David Isaac Gaines, Ashley Hawkins, Caroline Ozment, Amy Bearden, Sarah Merritt, John Cunningham, Elizabeth Palmer, Amir Contractor, and Leo Pezzementi. 1998. cDNA cloning, *in vitro* expression, and biochemical characterization of cholinesterase 1 and cholinesterase 2 from amphioxus: comparison with cholinesterase 1 and cholinesterase 2 produced *in vivo*. **Eur. J. Biochem.**, 258, 419-429.
- Leo Pezzementi, David Sutherland, Michael Sanders, Weily Soong, Daniel Milner, James Scott McClellan, Mathew Sapp, William Blake Coblenz, Gabriel Rulewicz, and Sarah Merritt. 1998. Structure and function of cholinesterases from agnathans and cephalochordates: implications for the evolution of the cholinesterases. In **Structure and Function of Cholinesterases and Related Proteins**, (B.P. Doctor, P. Taylor, D.M. Quinn, R.L. Rotundo, and M.K. Gentry, eds.), Plenum Press: New York, pp.105-110.
- David Sutherland, James Scott McClellan, Daniel Milner, Weily Soong, Neal Axon, Michael Sanders, Alison Hester, Yu-Hsing Kao, Ted Poczatek, Sheri Routt, and Leo Pezzementi. 1997. Two cholinesterase activities and genes are present in amphioxus. **J. Exptl. Zool.**, 277, 213-229.
- Michael Sanders, Bonnie Mathews, David Sutherland, Weily Soong, Harry Giles, and Leo Pezzementi. 1996. Biochemical and molecular characterization of acetylcholinesterase from the hagfish *Myxine glutinosa*. **Comp. Biochem. Physiol.** 115B, 97-109.
- Leo Pezzementi. 1994. **Research in Biology at Primarily Undergraduate Institutions**. Council on Undergraduate Research, Collegiate Research Association of Biologists: Asheville, NC, 344 pp.

## Leo Pezzementi - continued

- Jean Massoulié, Leo Pezzementi, Suzanne Bon, Eric Krejci, and François-Marie Vallette. 1993. Molecular and cellular biology of cholinesterases. **Progress in Neurobiology** 41, 31-91.
- Christopher Atkins and Leo Pezzementi. 1993. Developmental changes in the molecular forms of acetylcholinesterase during the life cycle of the lamprey. **Comparative Biochem. Physiol.** 106B, 369-372.
- Leo Pezzementi, Michael Sanders, Todd Jenkins, Dan Holliman, Jean-Pierre Toutant, and Ronald J. Bradley. 1991. Structure and function of cholinesterase from amphioxus. In, **Cholinesterases: structure, function, mechanism, genetics and cell biology** (J. Massoulié, F. Bacou, E. A. Barnard, A. Chatonnet, B.P. Doctor, and D.M. Quinn, eds.). American Chemical Society: Wash., D.C., pp 24-31.
- Howell Heflin/Leo Pezzementi. 1990. Remarks of Dr. Leo Pezzementi, Birmingham-Southern College. **Congressional Record-Senate** S10899.
- Leo Pezzementi. 1990. NIH AREA Program from the perspective of undergraduate research. Council on Undergraduate Research Newsletter 11, 57-60.
- Leo Pezzementi, Hugh C. Nickson, Robert Dunn, and Ronald J. Bradley. 1989. Molecular forms of acetylcholinesterase from the skeletal muscle of the ammocoete of the lamprey *Petromyzon marinus*. **Comp. Biochem. Physiol.** 92B, 385-387.
- Leo Pezzementi, Hugh C. Nickson, and Ronald J. Bradley. 1988. Lamprey brain contains globular and asymmetric forms of acetylcholinesterase. **Neurochem. Int.** 12, 131-135.
- Leo Pezzementi, Ellen J. Reinheimer, and Maureen Pezzementi. 1987. Acetylcholinesterase from the skeletal muscle of the lamprey *Petromyzon marinus* exists in globular and asymmetric forms. **J. Neurochem.** 48, 1753-1760.

**Curriculum Vita**

**John Preston Miles**  
 350 Harberson Lane  
 Danville, KY 40422  
 859-238-5414  
 miles@centre.edu

**EDUCATION**

University of Kentucky  
 Ph.D. analytical chemistry, 1975  
 Dissertation: inorganic crystallization chromatography

Centre College  
 B.A., 1970  
 Major: Chemistry; minors: physics and math

**PROFESSIONAL EXPERIENCE**

2002	Research Associate - Biological Mass Spectrometry Group, Oak Ridge National Labs
1997-present	John C. Walkup Professor of Chemistry, Centre College Courses taught: instrumental analysis (CHE 36 & 37), quantitative analysis (CHE 26), introductory chemistry (CHE 11 & 23), two-term integrative natural science sequence for non-majors (NSC 11 & 12). Coordinator of grants activities for Division of Science and Mathematics. Advisor to student affiliate A.C.S. group. Chair, Enrollment Management Committee. Member, Priorities and Planning Committee.
1991-1996	Program Director, Howard Hughes Medical Institute grant
1988-1994	Chair, Division of Science and Mathematics, Centre College Responsible for planning and coordination of program in physics, biology, chemistry, psychology, mathematics, biochemistry, and computer science. 27 faculty and 4 staff.
1988-1997	Associate Professor of Chemistry, Centre College
1986-1989	Director, Senior Scholars art Centre, Centre College Responsible for planning and administration of three-week summer enrichment program for talented high school students. Approximately 55 students in four courses each summer.
1981-1988	Assistant Professor of Chemistry, Centre College
1979-1981	Director, Analytical Research and Development, Rosa Laboratories Management and coordination of three departments. Total staff of 46 (16 professional, 30 technical). Reporting to Vice President for Research and Development.
1978-79	Manager, Analytical Research, Ross Laboratories, Columbus, Ohio
1975-1978	Senior Chemist, Analytical Research, Ross Laboratories

Preston Miles -continued

### **SELECTED RESEARCH AND CONSULTING**

Director: Twenty-four undergraduate collaborative research projects, primarily analytical methods development utilizing techniques of gas chromatography, HPLC, radio-immunoassay, ion-selective electrodes, enzymatic/fluorometric assay, and ion chromatography

Sponsor: Nine student paper presentations to Kentucky Academy of Science, 1982-1998

Consultant to: Signet Systems, Inc., Harrodsburg, KY, 1990: Environmental Health Research and Testing, Cincinnati, OH, 1983-1986

"Social and Environmental Indices of Stress in Captive Woolly Monkeys (*Lagothrix lagotricha*)," North American Regional Woolly Monkey Studybook, 1988, with B. White, S. Dew, & S. Schneider

"Analytical Methods for Lead in Infant Formula," JAOAC, 65, 1016 (1982)

"Infant Formula Physical Stability," JAOAC, 65, 1482 (1982)

"Determination of Iodide in Nutritional Beverage Products Using an Ion Selective Electrode," JAOAC, 61, 1366 (1978)

Research grants for summer research from Abbott Laboratories (1982 and 1983), New York Zoological Society (1985 and 1986), and Centre College (1987, 1991-1998)

"Comparison of Student Performance in Non-majors and Science Majors Introductory Chemistry Courses," presentation to Kentucky/Tennessee Academy of Sciences Meeting, November 1995

### **SELECTED COMMUNITY INVOLVEMENT**

Vice Chair, Boyle County Board of Education

Member, Danville Rotary Club

Elder and Teacher, First Presbyterian Church of Danville

**Appendix G**

**Suggested Outside Reviewers**

**Suggested Outside Reviewers**

1. Dr. Robert W. Ridky, Education Program Coordinator  
USGS  
John W. Powell Federal Building  
12201 Sunrise Valley Drive  
Reston, VA 20192  
Phone: 703-648-4713  
email: rridky@usgs.gov
  
2. Dr. Judy Giesen, Director  
Research Assistance Laboratory  
Department of Education Research  
University of Alabama  
306 Carmichael, Box 870231  
Tuscaloosa, AL 35487  
Phone: 205-348-4081      FAX: 205-348-0683  
email: jgiesen@bamaed.ua.edu
  
3. Dr. Julie Libarkin  
NSF Postdoctoral Fellow in SMET Education  
Science Education Department  
Harvard College Observatory  
60 Garden Street MS-71  
Cambridge, MA 02138  
Phone: 617-496-4795      FAX: 617-496-5405  
email: jlibarkin@cfa.harvard.edu
  
4. Dr. Jeffrey E. Fieberg  
Assistant Professor of Chemistry  
Georgetown College  
400 E. College Street  
Georgetown, KY 40324  
Phone: 502-863-7080  
email: Jeff\_Fieberg@georgetowncollege.edu
  
5. Dr. Lee Roecker  
Associate Professor  
Department of Chemistry  
Berea College  
Berea, KY 40404  
Phone: 859-985-3318  
email: Lee\_Roecker@berea.edu