ACS Science Reform Mini-Grants

This consortial program is supported by the W.M. Keck Foundation of Los Angeles

Proposal Cover Sheet

Project Title: ***Re-imagination of Interdisciplinary Non-majors Science: The Physical and Living Universes Revealed***

Faculty Name: Nicholas Schisler, Assistant Professor, Biology Department
Mike Winiski, Instructional Development Consultant, Center for Teaching and Learning

Institution: Furman University
Faculty Departments: Biology and Center for Teaching and Engaged Learning
Faculty Address: Furman University, 3300 Poinsett Highway, Greenville, SC 29613

Phone: (864) 294-3243 **Fax:** (864) 294-2058 (Schisler)
E-mails: Nicholas.Schisler@Furman.edu Mike.Winiski@Furman.edu

Amount requested: $14,056.00

Date grant submitted: December 1, 2006

Proposed grant period: June 2007 – August 2008

Type of project: New Course Development

Signatures of faculty submitting proposal:

_________________________	_________________________
Nicholas Schisler Date: December 1, 2006	Mike Winiski
_________________________	_________________________
Joseph Pollard, Chair Biology	Thomas Kazee, Acting President *(Vice President of Academic Affairs and Dean during Project Period)*
Date: December 1, 2006	Date: December 1, 2006

Evidence of institutional support is required for each mini-grant proposal in the form of a letter of support from the proposal author's Department/Division Chair or Dean of Science.

For ACS Office use only
Date received____________________ By_________________________
Date sent to review Committee________________________________
Action____________________ Notification sent______________________

Summary

Furman University is poised to institute a new interdisciplinary curriculum in the 2008 academic year that simultaneously restructures the general education requirements and shifts the academic calendar from a trimester to semester system. As a liberal arts institution that values engaged student learning, this change provides a unique opportunity to revisit the way we think and present our core requirements, and in this case: the empirical study of the natural world. This proposal requests funding to develop two new courses through re-imagining and reconceptualizing two dormant non-science major courses Science 16: The Structure of the Universe and Science 17: The Changing Universe. Co-creating *The Physical and Living Universes Revealed,* will allow us to tailor these courses to fit our new calendar and support active student exploration that dovetails with the new curriculum.

Our objectives are designed to provide flexibility to non-science majors by offering an interdisciplinary option for students who prefer to develop familiarity with the broad disciplines of biology, chemistry, physics, and earth and environmental science while retaining an opportunity for in-depth analysis of current controversial issues. In particular, we will emphasize in these re-envisioned courses:

- hands-on inquiry and experimentation;
- expansion of research skills to include the ability to locate primary scientific data;
- development of critical thinking skills to assess technical data and apply it to problem-solving;
- advancement of written communications skills, especially in the areas of thesis formation, logic, and rhetoric;
- development of oral communication skills in the multimedia environment;
- development of an historical and social awareness of societal issues in science.

The two courses and corresponding activities will be developed collaboratively by faculty, students, and educators under the direction of Furman's Center for Teaching and Engaged Learning. We anticipate working within a fourteen week semester framework that will involve three one hour sessions and one three hour laboratory. Two of the three one hour sessions may involve faculty-animated discussions that will feature multimedia presentations, demonstrations and activities designed to re-create historical experiments and engage students in critical discussion and interdisciplinary knowledge construction. The third weekly one hour session may be devoted to student-led presentations featuring topics of contemporary interest. The laboratory provides opportunities to use inquiry-based methods and research-grade equipment to explore science. Shorter, instructor-provided laboratories would give way to student-designed investigations.

Situated within the context of a new curriculum and calendar, these courses will align and connect with other student experiences, developing deeper connections across disciplines. Students will not only understand science in a historical context, they will experience the significant paradigm shifts in the field through active engagement. The resulting courses will be agile, in order to accommodate new findings and address current events. Curricular materials resulting from this project will be organized in a fashion to promote reuse, yet provide flexibility for modification to match changing instructor expertise and student interest.

Project Description

Introduction and Background

In *Science for All Americans*, the American Association for the Advancement of Science (AAAS) stresses the necessity of curriculum reform in order to accommodate a rapidly expanding body of scientific knowledge and to address widespread scientific illiteracy. According to the report, "the present curricula in science and mathematics are overstuffed and undernourished" (Rutherford & Ahlgren, 1990, p. viii). An over-emphasis on facts, without context or experience, often fails to provide learners with meaningful experiences that consider the way in which learners actually construct and incorporate new knowledge. Cognitive research suggests for significant learning to occur, prior learning, the interaction of facts and conceptual frameworks, and the development of metacognitive strategies must be considered and factored into instructional design (Bransford, Brown, & Cocking, 2000). This instructional context can also potentially influence motivational factors that impact learning (Eccles & Wigfield, 2002). Experiences conducive to significant learning are often constructivist in nature, paralleling the process of doing science including research, labwork, collaboration, application, communication of results, and an interdisciplinary focus (Narum, 1993).

An integral step in moving the curriculum towards such a vision is the creation of standards, such as those outlined *in Benchmarks for Science Literacy*, which include a focus, not only on content, but essential processes, societal factors, and relationships between traditional disciplines (Rutherford, 1993). Although benchmarks have been targeted primarily at the K-12 student population, Nelson contends that standards are entirely appropriate for undergraduate students and proposes setting an aggressive target date of 2011 for higher education institutions to meet these goals (Nelson, 2002). The AAAS also stresses the need for higher education involvement and alignment and proposes curriculum redesign and faculty pedagogical development (Rutherford, 1998).

Using past course development efforts (Deeds & Allen, 2000), literacy benchmarks, active learning pedagogies, and existing course redesign strategies (Fink, 2003) as a guide, we propose to completely re-imagine and re-design the interdisciplinary science courses for non-majors, Science 16 and Science 17. Collaborators from Furman's Center for Teaching and Learning (CTEL), trained in course redesign strategies, will facilitate the process of establishing and aligning course goals, module development, timelines, and assessment.

Goals and Objectives

Our goals align with those stated by the AAAS and include: demonstration of the inter-disciplinary nature of scientific discovery through experimentation and discussion, promotion of critical thinking skills applicable to problems encountered both inside and outside the classroom, advancement of written and oral communication skills, facilitation of hands-on inquiry and experimentation, advancement of research skills, and development of a historical and social awareness of societal issues in science. These goals should be undertaken in an atmosphere that the students find engaging and stimulating, and within a framework that facilitates mutual understanding, cooperation, and respect among students.

Inter-disciplinary Nature of Science

In the report "Bio2010: Transforming Undergraduate Education for Future Research Biologists" (2003) The National Institutes of Health (NIH) and the Howard Hughes Medical Institute (HHMI) view scientific research as increasingly interdisciplinary. The report states that students of science should start making connections among the disciplines of mathematics, biology, chemistry, physics, computer science, and engineering as soon as possible. Such an interdisciplinary approach to science education should also apply to the non-science major. Non-science majors represent the largest proportion of students in undergraduate educational institutions. These students deserve an opportunity to experience the sense of the excitement that comes with scientific exploration and the expanded understanding that comes from viewing the world through a scientific "lens". While Furman students who take these courses may not go on to become scientists, as members of our increasingly complex and interrelated society, a rich understanding of scientific issues can inform decisions and enhance other professional perspectives.

Critical Thinking

Although it is important to become conversant with the history, vocabulary, tools, and methods of a discipline, application of what is learned is critical in developing an independent ability to evaluate novel concepts and ideas. An obvious place to incorporate this material is the laboratory, where sessions will be designed as systematic, guided learning exercises. However, exploratory learning will not be limited to officially designated lab periods. Opportunities for incorporating shorter periods of collaboration and investigation will be explored during the course development phase that the grant is designed to support. Students would begin the term by working on instructor-supplied experiments and work towards designing their own experiments. More advanced application of critical thinking skills may be embodied in the debate of controversial scientific problems or in writing critiques of published articles from the scientific literature or popular press. To facilitate student participation at various levels of cognitive development, appropriate supplementary material must be made available. To this end, a variety of resources will be provided on multimedia-rich course web pages.

Written Communication

All college students need skills in written discourse, logic, and rhetoric and can benefit from hypothesis-generation, data collection, interpretation and analysis that are central to the scientific repertoire. This course will enhance the student's ability to communicate by incorporating multiple short laboratory reports and formal written critiques of scientific ideas. Written reflection will be solicited at the end of each discussion session and through informal written critique of presented ideas addressing the impact of these ideas on their life.

Oral Communication

Public speaking is another art that must be developed in the college student. In the proposed courses, groups of students will be given a controversial topic to research and present to the class, each taking opposing viewpoints. By providing opportunities for students to communicate and work with their peers, we not only build students' confidence but also build community, and team-based abilities. For those students who experience education as a competitive process Such collaborative approaches help increase appreciation for peer contributions and develops a relaxed learning atmosphere that facilitates the sharing of information and ideas.

Active Learning

Learning by doing is an important concept in teaching and one that should be used in all undergraduate science courses. For example, the living world could be introduced using simple, inexpensive experiments (e.g., measuring the surface area used for gas exchange in different plants, crossing fruit flies to examine Mendelian ratios, or examination of chicken embryo to discern changes during development) in a "discovery" process and concepts collaboratively developed through discussion and instruction. Science courses also encompass intensely visual and dynamic subjects. Digital images, video, and animations will be liberally used. When dynamic processes "come alive," learning is facilitated. We anticipate creating space for informed discussions by developing internet-based learning modules that will allow students to master select content (modules will include text, tables, pictures, diagrams, and in the future, animations and videos).

Research Skills

Development of information literacy supported through library- and internet-based research skills will also be encouraged in the proposed courses. Independent or group projects can foster a sense of ownership by students which may encourage them to investigate a topic in greater detail, especially if the answers to their questions are not readily apparent.

Development of Historical and Social Awareness

Awareness of various scientific issues that impinge upon the everyday life of our families, communities, nations, and planet is increasingly critical. Students should be aware of the rich history of science, its personalities, the natural forces that have shaped current social problems, and what scientists have done and can do to address them. Everyone can be inspired by the history of science and great scientific breakthroughs if engagingly encountered. Re-creation of historical experiments and use of original scientific publications will also be explored to help students conceptualize the perspective of the times. The proposed courses will expose students to current scientific and social debate using numerous contemporary issues, including climate change, extinction, resource depletion, famine, genetic engineering, etc. Consideration of such topics underscore that our current understanding of science arrived only after centuries of thought, experiment, and debate, and that those who make important contributions to science are "standing on the shoulders of giants" and were once students themselves.

Detailed Project Plan

Instructor- Animated Discussions

Instructors will use multimedia presentations that incorporate digital video and dynamic web-based data to illustrate the historical development of scientific ideas that culminated in the major scientific discoveries of recorded human history. Although content will be split between two courses: Science 16: The Physical Universe and Science 17: The Living Universe for organizational purposes, the interdisciplinary nature of discovery will be emphasized. Demonstrations or activities that re-create historical experiments or illustrate basic scientific concepts will be included in each session. We will explore soliciting student opinion using 'clicker" technology; students will be expected to discuss and debate ramifications of these discoveries in contemporary society. Potential topics that will be explored during this development period are listed in Table 1. Support is requested (see budget) for faculty release time to design the course generate course content.

Student-Animated Discussions

To ensure engagement, depth of understanding and relevance, students will participate in a wide range of activities, but a focal point will be their taking the lead on responding to controversial issues and prompts. Group work and team-based explorations will culminate in presentations and annotated referenced abstracts that examine the historical background, scientific foundation, and public perception of such controversial scientific issues. Students could also research and explore different perspectives on an issue using critical analysis of available scientific data and then develop a framework for successful conflict resolution that can be used in subsequent classroom discussions. One class period per week will be devoted to student-led presentations. Proposed topics are listed in Table 2. Support is requested (see budget) to assemble a library of appropriate reference materials including books and videos that would appropriately supplement those currently found in the university library.

Laboratory

Laboratories will be inquiry-based and designed to investigate contemporary, real-world issues using research-quality laboratory equipment. Students will be expected to assimilate background information, pose questions and hypotheses, conduct experiments, collect and analyze data, and interpret results to draw conclusions – in essence become scientists themselves. Some laboratories will feature multi-week experimentation and data collection (e.g. Testing the Health of Furman Lake); all will provide opportunities for students to devise and conduct their own experiments based upon their own observations and questions. Laboratories will be selected to complement material presented and discussed in class and will be scheduled on a weekly basis with a minimum of twelve sessions conducted each semester. Potential topics for the laboratory are listed in Table 3. Support is requested (see budget) to assess, identify and pre-test laboratory methods and, once affirmed, produce lab guides that summarize procedures. Ongoing support for lab materials will be handled by standard course lab fees.

Projected Timetable

Spring 2007	Participating faculty will read *Science for All Americans* (Rutherford and Ahlgren, 1990) and then work with CTEL to explore course redesign models, structure a preliminary syllabus, identify key concepts and activities, and finalize course topics, issues and focus.
Summer 2007 **Begin Grant Period**	Development of 12 Physical and 12 Biological Science laboratory modules that complement course topics. Development of Physical and Biological Science discussion-evoking demonstrations that complement course topics.
Fall 2007 – Spring 2008	Development of instructor-animated discussion materials. Possible pre-testing of sessions, materials, labs and units in First Year Seminar or appropriate introductory science courses.
Summer 2008 **End Grant Period**	***Finalization of all teaching materials.*** Report on Grant activities, products and outcomes Construction of course web site and online evaluation system.
Fall 2008 ***Spring 2009***	Teaching of The Physical Universe for the first time. Teaching of The Biological Universe for the first time. Supplemental Report (if desired); Additional reflection and dissemination based on first teaching of courses

Requested Budget

1.	Course development release time (/stipend) for summer 2007-2008		
	Faculty	$4,000	Shared across 2-3 faculty
	Benefits	$306	(FICA)
2.	Student Wages	$3,250	1 Students, 10 weeks to assist in the development of laboratory and demonstration modules
3.	Books and Media	$1,500	Representative books and films supporting course content (PBS, Discovery channel)
4.	Computer Interfaces and Probes	$2,000	Examples: Vernier LabPro Computer Interfaces; Accelerometer Probe; Magnetic Field Sensor
5.	Laboratory Materials/Consumables	$2,000	Laboratory Kits to explore for use/integration into course exploration activities (examples: Crime Scene Investigator PCR Kit; LaMotte Water Quality Test Kit)
6.	Dissemination: Website Construction, Conference Presentations and Travel	$1,000	Supplemental funds – appropriate venues finalized during the course of the project
	Total	**$14,056.00**	To fund development of 2 courses

Budget Notes

This proposal is structured to accommodate development of a pair of courses. Each course is projected to cost approximately $7,000 (coming under the $10,000 maximum). If funding is available only to support a single course, or one course and several additional modules, we will be willing to adjust our plans accordingly and seek other funding as necessary to complete our goal.

(1) Faculty release time / stipend - $4000 + $306 - Up to three faculty from different departments will be supported mainly during the summer months of 2007 to supervise student workers, generate content for use in discussion and laboratory, and devise a comprehensive course web site.
(2). Student wages - $3,250 - One student will be paid a stipend of $3250 over 10 weeks to assist with development of laboratory and demonstration modules.
(3) Books, Videos and Software - $1500 - Funds will be allocated for the purchase of reference materials not found in the library i.e. science video series that have appeared on the Discovery Channel and PBS and software to develop the course web site. (e.g. The Day the Universe Changed –DVD set $750; Connections, Connections2, Connections3 - DVD Sets $450).

(4) Computer Interfaces and Probes - $2000 - E.g. Vernier LabPro LabPro Computer Interfaces (2) - $220 each; Accelerometer Probe (1) - $200; Magnetic Field Sensor (1) - $56
(5) Laboratory Consumables - $2000 - e.g. Crime Scene Investigator PCR Kit - $169.00; LaMotte Water Quality Test Kit - $360.
(6) Dissemination: Website Construction, Conference Presentations and Travel - $1000 – Strategies and locations to be finalized during the course of the project, but targeted towards professional visibility and access through support website(s), presentations at workshops or meetings of ACS (Associated Colleges of the South), AIS (Association for Integrative Studies) conference, Teaching Philosophy, SoTL (Scholarship of Teaching and Learning) conferences, and related disciplinary and interdisciplinary conferences and workshops.

Institutional/Sustainable Budgetary Contributions

(1) Budget items are for development purposes only; science courses at Furman University charge $60/student thus approximately $2000/class will be available each term for supplies.
(2) Instrumentation (e.g. microscopes, spectrophotometers, thermal cyclers, etc), apparatus (e.g. glassware etc), and some supplies will be gathered from participating science departments

Curricular Context

Furman University recently completed a system-wide curricular review. In the summary document "Invigorating Intellectual Life: A Proposal for Furman University Academic Program and Calendar" a new roster of general education requirements was adopted that includes the following areas:

Empirical Studies (4 courses)
- Two courses in the empirical study of the natural world (1 with lab)
- Two courses in the empirical study of human behavior and social relations

Human Cultures (3 courses)
- A course using historical analysis to study past human interactions
- A course in the critical, analytical interpretation of texts
- A course (or 4-credit equivalent) in the visual or performing arts

Mathematical and Formal Reasoning (1 course)
Foreign Language (1-3 courses)
Ultimate Questions (1 course)
Body and Mind (1 course)
Global Awareness Requirements (2 courses)
- Humans and the Natural Environment (1 course)
- World Cultures (1 course)

This new structure is interdisciplinary by design, as can be seen in the orientation towards perspectives or "ways of knowing the world" and the lack of reference to specific courses, disciplines or departments. The proposed non-major science courses would fulfill the "empirical study of the natural world" requirement.

Together with the curriculum restructuring, Furman has instituted a calendar change that is scheduled to be instituted beginning Fall 2008. Furman will move from a trimester model to a semester model and the current 5 day, 50 minute class schedule norm will shift to more standard meeting times of 2-3 times per week. In addition, Furman will establish a First Year Seminar for incoming students aimed at engaging them in interdisciplinary, intellectual exploration and inviting them into a vibrant academic community that challenges perspectives and worldviews.

These changes and their associated timetables offer both challenges and opportunities. The primary challenge is that it will be impossible to teach these course fully before the new calendar takes effect. It may be possible to pre-test modules and units within and even pilot a specific component in a First Year Seminar course (that could be run, as a special topics course prior to 2007/2008). If funded, we would actively explore these options to ensure tested materials and designs by the end of the grant period.

As previously stated, the proposed non-major science courses re-imagine and re-design the interdisciplinary science courses for non-majors, Science 16: The Structure of the Universe and Science 17: The Changing Universe. These courses, although listed in the Furman University Course Catalog, have not been taught in recent years for the following reasons:

(a) Lack of faculty willing to undertake an interdisciplinary team-taught course.
(b) Restrictive scheduling i.e. both courses must be taken in sequence for credit.
(c) Availability of other discipline-specific non-major options.

This proposal and the resulting courses will address these curricular issues in the following ways:

(1) Rather than relying solely on individual faculty participating in tag-team approaches to teaching this course, resources will be developed through this project that will make it possible facilitate the teaching of the courses by any faculty or team with a background in science.
(2) The proposed courses may be taken together or independently with another discipline-specific course. The focus of the proposed non-majors courses is the development of scientific ideas using examples from all the sciences. Content duplication with discipline-specific courses may exist but would be minor.
(3) The advent of new first year seminars, required of all students and taught by all departments, may result in a reduction in the number of non-major science courses by the science faculty; incorporation of the proposed courses into the curriculum will result in greater options for non-science major.

Institution Impact

Furman University, an elite, highly selective, residential liberal arts college, currently ranked forty-first among national liberal arts colleges as reported by *US News and World Reports* has a reputation for offering some of the best undergraduate instruction in the sciences in the United States. It services approximately 2600 students, all of whom must take two courses to fulfill the empirical study of the natural world general education requirement. Among science departments (biology, chemistry, computer science, earth and environmental science, and physics) 20 - 25 non-majors science courses are offered each year. These proposed non-major science courses offer what we believe could be a popular, interdisciplinary alternative. Furthermore, a $60 million dollar renovation of our science complex will undoubtedly generate increased awareness and interest in the sciences among our students. These proposed courses could help to meet the increased demand.

Evaluation, Dissemination, and Continued Support

Evaluation and Assessment

A combination of summative and formative assessment will be implemented to measure project success. While standardized summative resources for evaluating scientific literacy exist (The PISA 2003 Assessment Framework, 2003), the measure of the degree to which course redesign has impacted scientific literacy is somewhat unique to each individual institution, course, and student level (Tobias, 1992). Therefore, research into and potential development of additional measures of scientific literacy, utilizing the resources available from Project Kaleidescope is anticipated (What Works, What Matters, What Lasts, 2006). Formative assessment, which will be designed and planned during the course development phase, will also be utilized to gauge project success and leveraged as a powerful instructional tool to inform instruction and encourage reflection and student-self assessment towards the development of metacognitive strategies (Fink, 2003; Wiggins, 1998). Assessment cannot be overlooked as one of the most powerful communicators of course curriculum, oftentimes overpowering the syllabus and verbal communications from the instructor with regards to desired outcomes and competencies. Rubrics and corresponding assessments must therefore be considered carefully and aligned with course goals (Tobias & Raphael, 1997). This we plan to do as part of the course re-imagining we will undertake.

Dissemination of Results

In *Scholarship Reconsidered* Ernest Boyer (1990) challenges universities “to break out of the tired old teaching versus research debate and define, in more creative ways, what it means to be a scholar” (p. xii). Boyer identifies four critical areas of scholarship including discovery, integration, application, and teaching, all of which inform course design. The latter, the Scholarship of Teaching and Learning (SOTL), emphasizes the importance of faculty research and dissemination of pedagogical discoveries. Furman’s strategic focus on curriculum redesign, along with institutional structures such as the Center for Teaching and Engaged Learning (CTEL), illustrate the institution’s commitment to engaged learning, SOTL, and the dissemination of pedagogical findings. This supportive infrastructure will facilitate the sharing of lessons learned within the university through faculty learning communities, sharing seminars, the CTEL website, and digital information stations in the newly renovated Charles H. Townes Center for Science. External communication may include journal publications, conference presentations (including ACS), and webinars with institutions interested in curricular development and course redesign.

Literature Cited

Bio 2010 Transforming Undergraduate Education for Future Research Biologists (2003). Washington, D.C.: The National Academies Press.

Boyer, E.L. (1990). *Scholarship reconsidered: Priorities of the professoriate.* San Francisco, CA: Jossey-Bass.

Bransford, J., Brown, A., & Cocking, R. (Eds.). (2000). *How people learn: Brain, mind, experience, and school.* Washington, DC: National Academy Press.

Deeds, D. G., & Allen, C. S. (2000). A new paradigm in integrated math and science courses. *Journal of College Science Teaching, 30*(3), 178.

Eccles, J. S., & Wigfield, A. (2002). Motivational beliefs, values, and goals. *Annual Review of Psychology, 53*(1), 124.

Fink, L.D. (2003). *Creating significant learning experiences: An integrated approach to designing college courses*. San Francisco, CA: Jossey-Bass.

Narum, J.L. (1993). *Occasional Paper I: What Works, 1993: A Research-rich Environment*. Retreived November 25, 2006 from http://www.pkal.org/documents/ResearchRich.cfm

Nelson, G. D. (2002). Science for all americans. *New Directions for Higher Education*, 119, 31.

The PISA 2003 Assessment Framework: Mathematics, Reading, Science and Problem Solving Knowledge and Skills (2003). OECD Publishing.

Rutherford, F. J. (Ed.). (1993). *Benchmarks for science literacy*. New York, NY: Oxford University Press.

Rutherford, F.J. (Ed.). (1998). *Blueprints online: Higher Education.* Retrieved November 25, 2006 from http://www.project2061.org/publications/bfr/online/HigherEd/text.htm

Rutherford, F.J, & Ahlgren, A. (1990) *Science for all americans*. New York, NY: Oxford University Press.

Tobias, S. (1992). *Revitalizing undergraduate science: Why some things work and most don't. An occasional paper on neglected problems in science education*. Tucson, AZ : Research Corporation.

Tobias, S., & Raphael, J. (1997). *The hidden curriculum--faculty-made tests in science. Part 1: Lower-division courses*. New York, NY: Plenum Press.

What works, what matters, what lasts: Assessing student achievement. (2006). Retrieved November 25, 2006 from http://www.pkal.org/collections/AssessingStudentAchievement.cfm

Wiggins, G. (1998). *Educative assessment: Designing assessments to inform and improve student performance*. San Francisco, CA: Jossey-Bass.

C.V. of Faculty Participant(s)

Nicholas J. Schisler
Assistant Professor
Biology Department
Furman University
Greenville, SC 29613

Tel. *(864) 294-3243*
E-mail: *Nicholas.Schisler@Furman.edu*
Web: http://fu-gold.furman.edu/schisler/index.html

a) Professional Preparation

Doctor of Philosophy, 1996
Department of Zoology (Genetics), University of Western Ontario, London, Ontario Canada N6A 5B7
Dissertation: The Antioxidant Enzymes (Superoxide Dismutase, Catalase and Glutathione Peroxidase): Their Molecular Evolution and Regulation in Mice.
Supervisor: Professor Shiva Singh

Honors Bachelor of Science, 1982
Departments of Zoology and Plant Sciences (Biology), University of Western Ontario, London, Ontario Canada N6A 5B7

b) Professional Appointments

Assistant Professor, 2003-present
Department of Biology, Furman University, Greenville, SC 29613

Assistant Professor, 2000-2003
Department of Biology, Pomona College, Claremont, CA USA 91711

Postdoctoral Researcher, 1996-2000
Department of Biology, Indiana University, Bloomington, IN USA 47405-6801
Project: Created annotated bioinformatic sequence databases and access software for use in studies of intron structure and evolution.

Laboratory Instructor, 1982-1987; 1995-1996
Department of Zoology, University of Western Ontario, London, Ontario Canada N6A 5B7

Director of Research and Development, 1990-1995
Autodata Marketing Systems Incorporated, 106-101 Cherryhill Blvd., London, Ontario Canada N6H 4S4

Special Projects in Higher Education Coordinator, 1990
Apple Canada, 7495 Birchmount Rd., Markham, Ontario Canada L3R 5G2

Consultant and Software Developer, 1987-1990
Apple Research Partnership Program, Computing and Communications Services, University of Western Ontario, London, Ontario Canada N6A 5B7

c) Publications

Qiu,W-G. Schisler,N. and A. Stoltzfus. 2004 The Evolutionary Gain of Spliceosomal Introns: Sequence and Phase Preferences. *Molecular Biology and Evolution*, 21: 1252 – 1263.

Schisler, N.J. and Palmer, J.D. 2000. The IDB and IEDB: intron sequence and evolution databases. *Nucleic Acids Research*. 28: 181-184.

Celerin, M., Gilpin, A.A., **Schisler, N.J.,** Ivanov, A.G., Miskiewicz, E., Krol, M. and Laudenbach, D.E . 1998. ClpB in a cyanobacterium: predicted structure, phylogenetic relationships, and regulation by light and temperature. *Journal of Bacteriology.* 180: 5173-5182.

Celerin, M., Ray, J.M., **Schisler, N.J.,** Day, A.W., Stetler-Stevenson, W.G. and Laudenbach, D.E. 1996. Fungal fimbriae are composed of collagen. *EMBO Journal.* 15: 4445-4453.

Hill, K.A., **Schisler, N.J.** and Singh, S.M. 1992. Chaos game representation of coding regions of human globin genes and alcohol dehydrogenase of phylogenetically divergent species. *Journal of Molecular Evolution.* 35: 261-269.

Schisler, N.J. and Singh, S.M. 1990. A quantitative genetic analysis of catalase activity in *Mus musculus*. *Biochemical Genetics*. 29: 65-89.

d) Synergistic Activities

Technology
- Molecular biological database design for bioinformatics research
- SQL database programming
- Apache and PHP World Wide Web site design
- Digital video capture and compression
- Unix system administration

Molecular Biological Techniques
- DNA amplification and analysis using PCR and gel electrophoresis
- DNA sequencing
- Bioinformatic analysis of DNA and amino acid sequences

e) Other Professional Affiliations

American Association for the Advancement of Science (1989-present)
American Society of Human Genetics (2000-present)
Council on Undergraduate Research (2000-present)
Genetics Society of America (1997-present)
Genetics Society of Canada (1986–present)
International Society for Computational Biology (1997-present)
National Association of Biology Teachers (1998-present)
Society for Molecular Biology and Evolution (1997-present)
Society of Systematic Biologists (1998-present)

Michael P. Winiski
Instructional Development Consultant
Center for Teaching and Engaged Learning
Furman University
Greenville, SC 29613
Tel. *(864) 294-2451*
E-mail: *Mike.Winiski@Furman.edu*
Web: http://ctel.furman.edu

a) Professional Preparation:

- B.S. Chemistry, summa cum laude, Furman University, Greenville, SC 1989.
  Research Advisor: Lon B. Knight.
- M.A. Education, Wake Forest University, Winston-Salem, NC 1995.
  Thesis Advisor: Professor Robert H. Evans.

b) Professional Appointments:

- Science Department Chairperson and Physics and Chemistry Instructor, Asheboro High School, Asheboro, NC, 1993-1998.
- Physics and Technology Instructor, Greensboro Day School, Greensboro, NC, 1998-2000.
- Java / Web Software Developer / Architecture Manager, Novell Inc., Greensboro, NC, 2000 – 2004.
- Internet Development Manager, Jefferson Pilot Financial, Greensboro, NC, 2004-2005.
- Java / Portal Software Developer, Wake Forest University, Winston-Salem, NC 2005-2006.
- Instructional Development Consultant, Furman University, Greenville, SC, 2006 – present.

c) Publications

- *The Effect of Learner Control on Achievement, Perceived Value, and Attitude in a Hypertext Chemistry Lesson.* Winiski, M.P.. *Thesis (M.A. Ed.)*, 1995, Wake Forest University.
- *Neon matrix electron spin resonance and theoretical investigations of* $^{10,11}BH_2$, $^{12,13}CH_2^-$, *and* $^{12,13}CH_2^+$. Knight, L.B., Winiski, M.P.; Miller, P.; Arrington, C.A., Feller, D.. *Journal of Chemical Physics*. 1989, 91(8), 4468-4476.
- *The generation and trapping of* $^{28}SiH_2^+$ *and* $^{29}SiH_2^+$ *in neon matrices at 4 K: Electron spin resonance and theoretical investigations.* Knight, L.B., Winiski, M.; Kudelko, P.; Arrington, C.A.. *Journal of Chemical Physics*. 1989, 91(6), 3368-3377.

d) Synergistic Activities

Technology

- Instructor, Novell portal and xml integration tools, 2004.
- Member of Novell's Open Source Community of Practice, 2004
- Workshop leader, Integrating Handhelds for Dynamic Assessment, Wake Forest University, 2003.
- Authored whitepaper "CVS - An Introduction to Open Source Version Control", Novell, 2004.
- Java Programmer Certification, 2002.

Education

- Education Consultant, eLearning Dynamics, Greensboro, NC, 2002- 2004.
- Science Olympiad Advisor and Science Club Advisor (1994 -1998), designed Regional Nature Quest Event (1997).
- Presenter at the North Carolina Science Teachers Association Convention, 1998.
- Highlighted in national magazine for activities used in the high school block schedule, National Education Association Magazine, March 1997.
- NC Science Teaching Certificate - science (covers physics, chemistry, earth science and astronomy).

e) Other Professional Affiliations

- International Society for Technology in Education Member, 2005 – 2006.
- Triad Physics Alliance, 1998 – 2000.
- North Carolina Science Teachers Association, 1996-2000.
- Master Teacher Cadre Program, Wheeling Jesuit University, Center for Educational Technologies / NASA's Classroom of the Future, 1997-1999.
- Teacher of the Year, Asheboro City Schools, 1998.
- Teacher of the Year, Asheboro High School, 1998.
- Phi Beta Kappa, 1988.

Disclosure Statement

The principal participants in the grant (Nicholas Schisler and Mike Winiski) have no on-going grant activities at this time. Nicholas Schisler will supervise three to four science majors' research during the summer months of 2007 and 2008. This will require approximately twenty-five percent of his available time. Mike Winiski is involved in an NSF Research Experience for Undergraduates (REU) grant that is undergoing review. If awarded, this grant will occupy up to twenty-five percent of his time in the spring and summer. These other responsibilities will not impact the completion or success of this proposed project.

Table 1 Proposed Instructor-Animated Discussion Topics

Science 16 The Physical Universe	**Science 17 The Living Universe**
1. The Planets Move (2000 B.C. – 500 B.C.) 2. The Earth Moves (1543) 3. The Law of Falling Bodies (1604) 4. Planetary Orbits Are Elliptical (1605 – 1609) 5. Jupiter Has Moons (1609 – 1612) 6. Universal Gravitation (1666) 7. Laws of Motion (1687) 8. Halley's Comet Has a Predictable Orbit (1705 – 1758) 9. The Milky Way Is a Gigantic Disk of Stars (1780 – 1834) 10. Oxygen (1770s) 11. Atomic Theory (1808) 12. Atoms Combine Into Molecules (1811 onward) 13. Synthesis of Urea (1828) 14. Chemical Structure (1850s) 15. Periodic Table of the Elements (1860s – 1870s) 16. Electromagnetism (1807 – 1873) 17. Electricity Transforms Chemicals (1807 – 1810) 18. The Second Law of Thermodynamics (1824 – 1850) 19. The Nature of Light (1704 – 1905) 20. Atoms Have Signatures of Light (1850s) 21. The Electron (1897) 22. Electrons for Chemical Bonds (1913 onward) 23. Radioactivity (1890s – 1900s) 11. Radiometric Dating (1907) 24. E = mc^2 (1905) 25. Special Relativity (1905) 26. General Relativity (1915 – 1919) 27. The Quantum Leap (1900 – 1935) 28. The Neutron (1935) 29. Nuclear Forces (1666 – 1957) 30. Quarks (1962) 31. The Universe Is Expanding (1924 – 1929) 32. The Center of the Milky Way Emits Radio Waves (1932) 33. Cosmic Microwave Background Radiation (1964) 34. Gamma-Ray Bursts (1969 – 1997) 35. Planets Around Other Stars (1995 – 2004) 36. The Universe Is Accelerating (1998 – 2000) 37. Magnetic Field Reversal (1906) 38. Continental Drift (1911) 39. Seafloor Spreading (1950s – 1960s) 40. Plate Tectonics (1960s) 41. Periodic Ice Ages (1930s) 42. Global Warming (late 20th century)	1. Human Anatomy (1538) 2. Blood Circulation (1628) 3. Microorganisms (1674) 4. Classification of Species (1735) 5. Photosynthesis (1770s) 6. Geological Change (1830s) 7. First Dinosaur Fossils Identified (1820s – 1840s) 8. Rules of Heredity (1850s) 9. Theory of Natural Selection (1858) 10. The Cell Nucleus (1831) 11. Cell Division (1879) 12. Sex Cells (1884) 13. Cell Differentiation (late 19th century) 14. Vaccination (1796) 15. Germ Theory (1800s) 16. Anesthesia (1842–1846) 17. X-rays (1895) 18. Neurotransmission (late 19th to early 20th century) 19. Blood Groups (1902) 20. Hormones (1903) 21. Vitamins (early 1900s) 22. Insulin (1920s) 23. Penicillin (1920s–1930s) 24. Sulfa Drugs (1930s) 25. Mitochondria (late 19th century to the present) 26. The Krebs Cycle (1937) 27. Ecosystem (1935) 28. Tropical Biodiversity (15th century to the present) 29. Genes Are Located on Chromosomes (1910 – 1920s) 30. Genes Control Biochemical Events (1930) 31. Some Genes Can Jump (1940) 32. DNA Is the Genetic Material (1928, 1944, 1952) 33. DNA Is a Double Helix (1953) 34. Cracking the Genetic Code (1960s) 35. RNA Conveys Genetic Information (1960s) 36. RNA Splicing (1976) 37. The Burgess Shale (1909) 38. Potential for Life Created (1953) 39. Archaea (1977) 40. New Life-forms Discovered Around Hydrothermal Vents (1977) 41. Australopithecus Afarensis or "Lucy" (1974) 42. Laetoli Footprints (1978) 43. Toumai skull (2002) 44. K-T Asteroid Theory of Dinosaur Extinction (1980) 45. Restriction Enzymes (1950s – 1960s) 46. Oncogenes (1975) 47. The Human Retrovirus HIV (1980s) 48. DNA Polymorphism (1985) 49. RNA Interference (1998) 50. Humans Have 20,000 to 25,000 Genes (2003)

Table 2 Proposed Student-Animated Discussion Topics

Science 16 The Physical Universe	Science 17 The Living Universe
1. Is Environmental Degradation Worsening? 2. Were Environmental Factors Responsible for the Mayan Collapse? 3. Is a Global Environmental Crisis Imminent? 4. Is the Threat of a Global Water Shortage Real? 5. Is the Threat of Global Warming Real? 6. Are Tighter Air Quality Standards Justified? 7. Is Municipal Waste Recycling Environmentally and Economically Sound? 8. Should the World Continue to Rely on Oil as a Major Source of Energy? 9. Should the Artic National Wildlife Refuge be Opened to Oil Drilling? 10. Nuclear Waste Disposal 11. Is Biological / Chemical Terrorism a Threat to the World Community? 12. Is Irradiated Food Safe to Eat? 13. Is Pesticide / Herbicide Exposure Harmful to Human Health? 14. Are Electromagnetic Fields Dangerous to Your Health? 15. Should Humans Go to Mars? 16. Is Time Travel Possible? 17. Is Hydrogen a Safe Alternative Fuel Source? 18. Is Light a Particle or a Wave? 21. Did Newton or Leibniz Invent Calculus?	1. Is World Population Growth Out of Control? 2. Does the Growing World Population Face Food Shortages? 3. Does Wilderness have Intrinsic Value? 4. Is Sustainable Development Compatible with Human Welfare? 5. Can Green Marketing Save Tropical Rain Forests? 6. Should Genetic Engineering be Banned? 7. Should Biotechnology be Used in Food Production? 8. Do Environmental Hormone Mimics pose a Potentially Serious Health Threat? 9. Does the Theory of Evolution Explain Human Origins 10. Should Human Cloning Be Banned? 11. Should There be a Market in Human Body Parts? 12. Should Abortions Late in Pregnancy be Banned? 13. Does Abortion Increase the Risk of Breast Cancer? 14. Should Patenting Life be Forbidden? 15. Should Health Insurance Companies Have Access to Information from Genetic Testing? 16. Is it Ethical to Sell Human Tissue? 17. Should Human Stem Cell Research be Banned? 18. Should Animal Experimentation be Permitted? 19. Should Race Play a Role in the Treatment and Study of Disease? 20. Does Health Care Delivery and Research Benefit Men at the Expense of Women? 21. Is Marijuana Dangerous and Addictive? 22. Are "Club Drugs" Dangerous? 23. Do the Consequences of Caffeine Outweigh the Benefits? 24. Should Children Be Immunized Against Childhood Diseases? 25. Should Tobacco Products be More Closely Regulated? 26. Should the Decision to Use Anabolic Steroids Be left to Athletes? 27. Should the Moderate Use of Alcohol be Recommended? 28. Is the Search for Extra-terrestrial Life Worthwhile?

Table 3 Proposed Laboratory Topics

Science 16 The Physical Universe	Science 17 The Living Universe
1. Measurement of Displacement, Velocity, and Acceleration in Everyday Objects. 2. Measurement of Centripetal Acceleration on Roller Coasters 3. Determination of the Speed of a Car using the Doppler Effect 4. Determination of the Conservation of Momentum using Collisions 5. Measurement of the Acceleration Due to Earth's Gravity. 6. Determination of the Orbital Period of Jupiter's Moons 7. Measurement of the Age of the Universe Using the Hubble Red-Shift 8. Conservation of Energy: Hot Wheels and Photogates 9. Measurement of the Speed of Sound 10. Evaporation and Intermolecular Attractions 11. Millikan Oil Drop Experiment Simulation 12. GIS –Exploring Plate Tectonics	1. Food Preservatives and Human Dietary Health 2. Antibiotics and Disinfectants: Rise of Drug-Resistant Bacteria 3. Toxicology: Effect of Chemical Contaminants on the Heart rate of *Daphnia* 4. Water Contamination: Testing the Health of Furman Lake 5. Toxicology: The Ames Test for Mutagens 6. Forensic DNA Fingerprinting using PCR 7. Human ALU Insertion Polymorphism 8. Identification of Genetically-modified Food using PCR