SCIENCE EDUCATION FOR NEW CIVIC ENGAGEMENTS AND RESPONSIBILITIES

SENCER

FORENSIC INVESTIGATION: Seeking Justice Through Science

GREGORY MILLER

(SOUTHERN OREGON UNIVERSITY)

The SENCER Model Series 2004

NOTE: Links to other documents and URL's are highlighted in yellow.

INTRODUCTION TO THE SENCER MODELS 2004:

A key element of the SENCER program's national strategy has been the selection and dissemination of "model" courses that connect science education and complex civic issues. These courses have been selected because we feel they are outstanding courses that exemplify the "SENCER Ideals." They have also been chosen because they embody the standards and principles of good educational practice set forth by others with a strong stake in improving education, including the "Principles of Learning" developed by the American Association for the Advancement of Science, the Learner-Centered Psychological Principles" of the American Psychological Association, and the recommendations of the Committee on Undergraduate Science Education of the National Research Council.

In SENCER's first three years we featured twelve models, and one "emerging" model developed by an institutional team as part of their participation in the SENCER program. These courses addressed topics as varied as HIV disease and Tuberculosis, bird migration, energy use, natural catastrophes, water quality, the geology of Africa, human genetics, nutrition, toxic brownfields, and global warming. In this, the fourth year of the program, we are pleased to feature six innovative courses or programs, five of which were developed by faculty participating in the SENCER project. Three of these models are designed as learning communities or linked courses, reflecting the growing institutionalization of approaches that link science learning to civic , policy, and other non-science content. These new models include courses that explore forensic science, coal in Appalchia, lead in urban environments, uranium on Indian reservations, and the mathematics behind cryptology and information processing, among other questions and problems.

All of these courses represent a range of science disciplines, instructional approaches, class formats, institutional settings, and degrees of formality. It is important to note that these are models of more than just single courses. They are also models of writing-across-the curriculum, interdisciplinarity, learning communities, team-teaching, undergraduate research and other pedagogical innovations within higher education. For all their variety, the models share important common characteristics. Each reflects considerable thought and planning. Each course foregrounds intentional pedagogical practice. Each can demonstrate successful learning outcomes for a diverse set of learners. Each has undergone a process of continuous development and improvement. Like all good courses, they represent works-in-progress, and the same could be said of the models series itself.

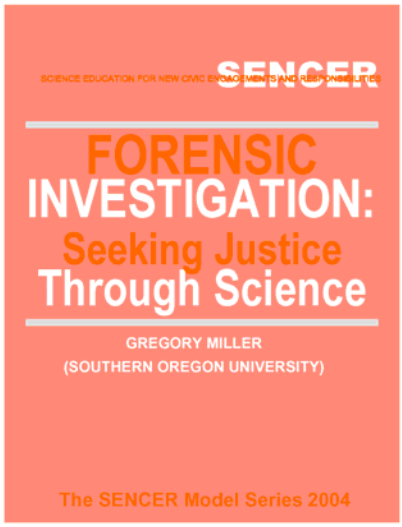
As in prior years, to guarantee the maximum accessibility, the models have been formatted primarily for electronic, rather than print, dissemination and both CD-ROM and Web versions are offered as downloadable PDF files The other significant change has been in the framing and organization of the models. In response to feedback we collected during the first year, the model developers have been asked to present their courses using the framework and categories of a typical faculty "course portfolio." This

has meant that the model developers were asked to reflect in greater detail on the relationship of their course to the overall curriculum, the general education program, and other academic goals and priorities at their specific colleges and universities. We hope that this framing of the models will not only be informative, but that it will also "model" a strategy of course presentation that faculty can use to make the strongest possible case for the value of their work to their institutions. In putting their work before their peers, the creators of these courses are themselves civically engaged. In their willingness to offer their work to colleagues for review, they have exposed themselves to possible challenges and criticism, but they have also provided important leadership in the effort to improve science learning. The success of these courses in their respective institutions provides powerful evidence that curricular innovation can lead to significant gains in student learning, especially for those who are not majoring in STEM fields. We are deeply grateful to the authors of these models for their generosity and their enthusiasm as they work with the participants of the SENCER Summer Institutes, as well as with others who share the goal of encouraging students to both learn more science, and engage more fully in the pressing civic problems of our time.

We anticipate publishing 25-30 SENCER models during this first phase of the project. However we are well aware that the courses we have featured are just a few of the hundreds of courses and programs that could be considered models of the SENCER approach. We plan to construct a Web-based, searchable database of courses and programs that embrace SENCER ideals, achieve both educational and civic goals, and have real heuristic value for faculty and we strongly encourage you to nominate courses for inclusion in this group. We need your criticism, feedback and suggestions on how we can improve the model series, but more importantly we need you to help us identify the outstanding courses and programs that will become next year's SENCER models. I look forward to hearing from you in the year ahead.

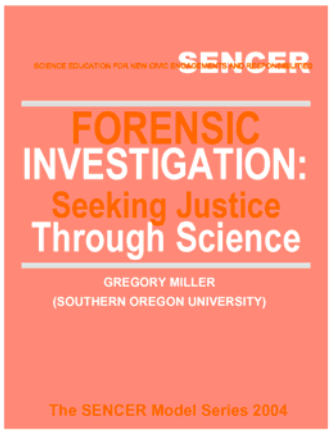
Eliza Jane Reilly
Editor, SENCER Model Series

Partial support for this work was provided by the National Science Foundation's Course, Curriculum and Laboratory Improvement Program under grant DUE-0088753.



***Introduction to Forensic Investigation: Seeking Justice Through Science* as taught by Gregory Miller at Southern Oregon University**

Course URL:www.sou.edu/chem/faculty/miller/forensics.htm



Why is Forensic Investigation a SENCER Model?

What are the capacious civic questions or PROBLEMS addressed in the course?

In the past decade, dozens of individuals have been exonerated of crimes for which they have been convicted and/or imprisoned. Popularized by the news and dramatic media, these shocking occurrences have come to light largely due to advances made in the multidisciplinary fields of forensic science. Forensics is now championed as the proof previously lacking in eyewitness testimony and identification.

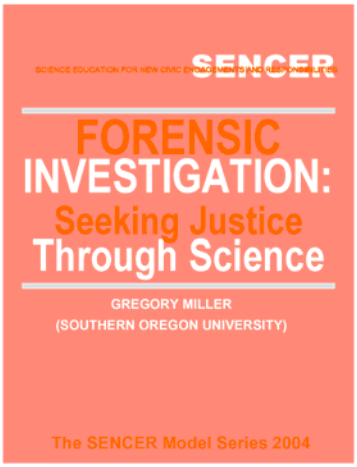
Society is and always has been intrigued by crime and mystery. Including some of the most popular on television, no fewer than twenty televised programs deal with solving crime and catching those persons responsible. Perhaps it is our fascination with death or a hope that justice will prevail should our own innocence be lost at the hands of an unknown assailant that gives these shows their widespread popularity. Unfortunately, television writers do not believe technical accuracy should stand in the way of a good mystery.

Whatever the case, the *Forensic Investigation* course developed at Southern Oregon University capitalizes on this popularity and deals with the methods and technologies of solving crime in America and abroad. The course allows students to observe how society has been changed by forensics and how forensic science has been changed by society. Along with the content of a typical forensic science class (outlined below), this class examines forensic methods as they relate to a sense of justice in the United States. Attention is given to wrongful convictions, the ethics of crime scene processing and criminal prosecution, moral aspects of defending suspects where the probability of guilt is high, the role of the media in criminal prosecution, and the fact that societal bias can exist in a scientific technique or method. It is felt that this course, as outlined below, not only gives students a fundamental background in many scientific principles (wrapped in a very interesting package), but also allows students to grasp and appreciate both the power and limitations of scientific methods or techniques.

What basic science is covered?

This course is incredibly broad in scope covering aspects of biology, chemistry, physics, computer science, psychology, and criminology. It is open to students of all majors at Southern Oregon University as part of our general education curriculum. Although "taught" by a single faculty member in the Department of Chemistry, the ability to successfully teach this class has been made possible through collaboration with other departments and faculty. Included in this collaboration is an ability to call on guest speakers – both University faculty and community members alike.

Forensic Content	Basic Science Covered	Societal Issues Addressed
Trace Evidence and Latent Fingerprint Detection	▪ Quantitative vs qualitative analysis ▪ Sample integrity ▪ Spectroscopy ▪ Scientific Method	▪ Ethics of crime scene processing; should all U.S. citizens and visiting foreign nationals be fingerprinted?
Arson and Explosives Investigation	▪ Basics of Chemistry – atoms, compounds, bonding, inorganic vs organic substances, and polarity ▪ Chromatography	▪ Defending those who are guilty
Forensic Toxicology and Pharmacology	▪ Organic functional groups and characteristics ▪ Concentrations and partial pressures ▪ Basics of Immunology	▪ Should specific drugs be legalized in America?
DNA Evidence and Serology	▪ Basics of Biology – cell structure, DNA (including structure and replication) ▪ Intro to genetics	▪ A history of wrongful convictions in the U.S. and the pros and cons of a national DNA database.
Forensic Pathology and Autopsy Procedures	▪ Soft tissue anatomy ▪ Physiology and mechanism of death	▪ The role of the media in criminal prosecution
Forensic Anthropology and Odontology	▪ Skeletal anatomy ▪ Demographics of age, sex, and race by exact measurement	▪ Forensic science is not immune from societal bias
Ballistics and Vehicular Accidents	▪ Basics of Physics – energy, mass, work, force, momentum, gravity	
Forensic Psychology and Criminal Profiling	▪ Personality traits ▪ Nature vs nurture debate ▪ "victimology"	▪ The dangers of stereotyping and racial profiling in criminal cases



The Course

Course Statistics

When has the course been offered:	First offering – Spring Quarter 2001 Most recent offering – Summer 2004
Average number of students:	40
Course Level:	Chemistry 300, Chemistry 301 (optional lab)
Prerequisites:	Completed Explorations sequences in Science, Social Science, and Arts and Letters

Course Management (Policies, procedures, logistics)

a. The forensics course consists of 3 weekly hours of "lecture" and a 3-hour laboratory period. One instructor teaches both the lecture and lab sessions as there are no TAs at SOU. Because this course is offered as a "Synthesis and Application" class, the laboratory is an optional component and more emphasis is commonly placed on in-class demonstrations. The lectures are very interactive with a typical class consisting of approximately 1/3 lecture, 1/3 debate or discussion (typically cases or societal issues), and 1/3 demonstration.

   The goals of this course are as follows:

   - To provide students with a foundation of knowledge in scientific methods and principles as they apply to criminal investigation
   - Allow students to apply appropriate scientific principles to societal issues

- Allow students to appreciate the power and the limitations of science with regard to forensic study
- Allow students to recognize that scientifically optimal solutions to societal problems may result in conflict with important human values
- To build in students the capacity to resolve complex issues with intelligence, compassion, and understanding
- To develop in students a healthy initial skepticism by nurturing a demand to support assertions
- To promote student critical thinking and allow informed choices to be made when faced with conflicting ideas
- To familiarize the student with available scientific resources and allow them the opportunity to remain an active learner as both science and society continue to evolve

b. *Forensic Investigation* makes use of classroom interactive technology – EduCue's Personal Response System (http://www.educue.com). This technology is used to keep students involved in class discussions by giving them the ability to share their opinions (mostly anonymously). For example, students are asked to vote on what they feel is the appropriate forensic technique to apply to a given case before, during, and after the content of the techniques are taught. The class results often facilitate discussion of the pros and cons of a given method. This technology is also used to monitor concept understanding and to allow students to "voice" their opinion on controversial topics or methods without fear of personal confrontation with peers having different views.

c. Each of the listed content areas is introduced with a real-life case study to draw student interest, provide a frame of reference, and stimulate thinking. If possible, many *local* cases are used in the course of each term (i.e., I-5 killer Randall Woodfield). However, there are a number of compelling national cases that have been used with great success:

Forensic Content	Case Studies Used
Trace Evidence and Latent Fingerprint Detection	▪ Richard Ramirez (LA Nightstalker) ▪ Wayne Williams ▪ DC snipers ▪ O.J. Simpson ▪ Jason Massey
Arson and Explosives *click here for Power Point presentation*	▪ Pan Am 103 bombing over Lockerbie ▪ Oklahoma City Federal Building bombing ▪ Intentionally set forest fires
Forensic Toxicology and Pharmacology	▪ Marilyn Monroe ▪ Stella Nickell ▪ John Belushi
DNA Evidence and Serology *click here for Power Point presentation*	▪ Green River killer ▪ O.J. Simpson ▪ Jeffery MacDonald ▪ Anastasia Romanov ▪ JonBenet Ramsey ▪ Unknown Soldier of Vietnam
Forensic Pathology and Autopsy Procedures	▪ Medgar Evers ▪ Louise Woodward ▪ David Koresh and the Branch Davidians
Forensic Anthropology and Odontology	▪ Joseph Mengele ▪ The Romanov family ▪ Ted Bundy ▪ Captain Anthony Shine
Ballistics and Vehicular Accidents	▪ John F. and Bobby Kennedy ▪ DC snipers
Forensic Psychology and Criminal Profiling	▪ Aileen Wuornos ▪ Susan Smith ▪ Great Train Robbery of southern Oregon

The lecture portion of each of the major content area is accompanied by a corresponding Power Point presentation. This presentation is made available to the students (via the web or Blackboard) prior to the class. The presentations serve as outlines the students can follow and I encourage them to bring printouts of the file(s) to class. Students spend

less time copying words and definitions and (in theory) more time listening to examples, listening to classmates voice their opinions, and/or thinking about the material being presented.

d. *Forensic Investigation* makes use of in-class demonstrations to reinforce concepts or methods that are not practical to perform in lab. Typical demos include color tests, chromatography, luminol detection, and latent fingerprint identification methods. The class also benefits from the fact that our instruments are on our campus commuter network. Using this network, it is possible to show the class how to set up and run instrumental methods. For example, the GCMS, with the help of our sample changer, can be set up and run from the classroom. Students watch data as it is collected in real time (while we do other things, of course).

e. The *Forensic Investigation* course is offered with an optional laboratory. As in any science, lab work allows the student hands-on experience with lecture topics and promotes a more secure understanding of the steps and procedures of a forensic technique. A laboratory sequence to compliment *Forensic Investigation* has already been tested. The 10-week lab general education lab includes the following topics:

   - Trace Evidence Analysis including hair, fiber, and glass
   - Latent Fingerprinting Methods including powders, iodine, ninhydrin, silver nitrate, and cyanoacrylate fuming
   - Gunpowder and Ballistics (bullets can be obtained from a local firing range or a class can actually test fire weapons at the proper location and with the proper guidance); lead and nitrite residue analysis is quickly and easily performed in the lab
   - Drugs in Blood, a toxicology lab featuring gas chromatography/mass spectrometry
   - Chromatography of Ink and Handwriting Analysis for aiding in the identification of suspects
   - Blood Typing and DNA Fingerprinting which introduces blood typing methods, gel electrophoresis, DNA fingerprinting strategies, and luminol detection of blood
   - A Mock Crime Scene where students employ learned laboratory methods to solve a fictitious crime. In springs of 2002-4, the faculty in the Departments of Biology and Chemistry graciously provided fingerprints and hair samples and became “suspects” for this lab. The lab is performed in teams of 3 or 4 students over the course of 3-4 weeks.
   - Writing and Communication Skills: The students file a report of their “crime scene” findings with their instructor and present their findings to the class as a group. Another student team acts as a defense

attorney for the “defendant” in the case. The remaining students act as the jury. The entire process can really demonstrate exactly how hard it can be to “prove” a case although the evidence may only point at a single suspect.

Both Prentice Hall (Saferstein – ISBN:0-13-020533-8)) and the CRC Press (Kubic – ISBN: 0-84-931508-5) publish laboratory manuals in Forensic Science. Forensic lab kits can be purchased through Edvotek (www.edvotek.com), Sirchie (www.sirchie.com), or Sargent-Welch (http://sargentwelch.com/category.asp_Q_c_E_26249). The labs above were designed through trial and error. Copies can be obtained by contacting Greg Miller at 541-552-6408 or millergr@sou.edu.

f. Students are asked to write and submit one term-long assignment. This may be either a short **research paper** on a forensic technique of their choosing or a **case study portfolio**. The paper should be in an acceptable scientific format and cite appropriate references. Examples are provided. This paper allows the student an opportunity to further investigate a topic covered in class or research forensic content that was not addressed by the course while, at the same time, giving them experience with scientific literature (including electronic research tools such as the General Science Index and analysis of science journal articles). For a case study portfolio, students are asked to compile a collection 4-6 related cases. For instance, the cases may be related in that they are all cases where innocent people have been convicted of a crime, they all deal with serial killers, or they all deal with the identification of skeletal remains. The students summarize each case in about one typed page. The summary must include a description of the forensic science that applies to the case. The students then summarize any observed trends in the cases in one final page.

g. Finally, *Forensic Investigation* makes use of guest speakers. To this point, speakers have included the lead Arson Detective for southern Oregon (and his accelerant detecting dog) and the Chief Deputy Medical Examiner of Jackson County. Both speakers presented local cases that reinforced concepts covered in class, addressed aspects of dealing with the media in regard to community sensitivity, discussed their background and the qualifications for their line of work, and spoke to the issue of fighting crime on smaller and smaller state budgets.

Syllabus

Introduction to Forensic Science
Chemistry 300
Spring 2004

Class Content:	This class introduces the scientific techniques used in the investigation of crime with particular emphasis on analyzing physical evidence. The class will also address aspects of how crime and our attempt to combat crime has influenced the world we live in. Attention is paid to wrongful convictions, the ethics of crime scene processing and criminal prosecution, moral aspects of defending suspects where probability of guilt is high, and the fact that societal bias can exist in what is perceived as a purely scientific technique or method.
Lecture:	10:00 – 11:15 a.m. TR
Instructor: **Office:** **Office Hours:** **Phone:** **E-mail**:	Gregory Miller Sc 262 MTWR 9-10 am or by appointment (541) 552-6408 millergr@sou.edu
Text:	Richard Saferstein *Criminalistics – Introduction to Forensic Sciences.* Eighth edition
Grading:	Grades will be based on the total number of points accumulated during the term and will be determined as follows: 100%-90%,A; 89%-80%,B; 79%-70%,C; 69%-60%,D. There will be two 100-point tests and a 100-point comprehensive final. The final exam score, if it is higher, will replace your lowest test score. In the event a test is missed, your final exam score will doubled. You will also be responsible for one term-long case study assignment, which will be turned in as a short portfolio of 4 to 6 cases no later than Friday, June 4. For this portfolio, each student will decide on a theme that will be consistent in all of the cases you choose (i.e., a specific serial killer, identification by facial reconstruction, or people who have been wrongly convicted). The purpose of this assignment is to compare and contrast a sample of similar crimes or scenarios and summarize trends observed in a short critical essay (4-8 typed pages). Each case should first be presented as a one-page (or so) summary highlighting specific instances where forensic tools have been instrumental in solving (or attempting to solve) the case. Further details will be given in class. See me anytime in my office for clarification. The only restriction to this assignment is a student cannot detail a case that is one we have covered in class. See me (or the class bulletin board) make sure we will not be using any of your potential cases in lecture this term. The portfolio is worth 100 points.

Test Schedule:

Test 1	*Thursday, April 22*
Test 2	*Thursday, May 20*
Final	*Tuesday, June 8, 7:30 - 9:30 a.m.*

Tentative Class Schedule:
(Saferstein Chapter #)

Week of:	
March 30	Introduction to Forensic Science (1, 2, 3) Basics of Chemistry
April 6	Latent Fingerprinting Techniques (14)
April 13.	Arson Investigations (5, 11)
April 20	finish Arson/Explosives, begin Forensic Toxicology/Pharmacology (9, 10)
April 27	finish Toxicology/Pharmacology.
May 4	Intro to Forensic Serology and DNA Techniques (12, 13)
May 11	finish Forensic Serology, DNA techniques
May 18	Forensic Pathology (not in text) Autopsy procedures (not in text)
May 25	Introduction to Forensic Anthropology and Odontology

Important Notes:

Please inform me if you know of any chemical allergies that you may have.

Attendance is not required but very highly encouraged.

A copy of this syllabus can be found, along with all PowerPoint presentations used in class, at the class website:
www.sou.edu/chem/faculty/miller/forensics.htm

National Evaluation:

As part of SOU's evaluation of this course, our class will fill out a brief evaluation of the course online. Please go to the following website to complete the short questionnaire at or near the end of the quarter:

www.wcer.wisc.edu/salgains/student/default.asp

The course ID number is 714708853 and the password is scienceisfun

Please bring me a printout of the screen obtained upon completion of this short questionnaire with your name written plainly on the front. Remember, the forensics gods are watching and will smile on you in the future for your effort. Your online answers are completely confidential. Thank you!!

Classroom Ethics: In all subjects, academic honesty is mandatory. Guidelines to SOU student conduct regarding plagiarism and other forms of academic dishonesty can be found on the web at http://www.sou.edu/studentrights/

SOU Disability Services: If you are in need of academic support because of a documented disability (whether it be psychiatric, learning, mobility, health related, or sensory) you may be eligible for academic accommodations through Disability Services for Students. Contact Margaret Dibb, Director, DSS, at 552-6213, or schedule an appointment in person at the Access Center, Stevenson Union, lower level.

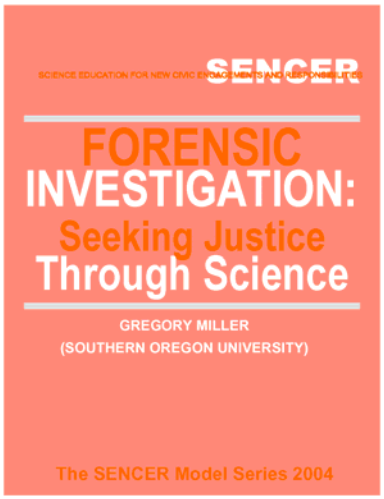
Supporting Material

Sample Test Questions

The tests in this class are often mixtures of multiple choice, short answer, and/or application questions. The relative percentages of each are largely based on the size of the class.

Forensic Jeopardy

Why have simple review session before a test when the class can play Jeopardy? This template was graciously provided by Bill Arcuri. The game can be played in teams or individually using the EduCue PRS system to "buzz in." Providing bells or horns (in place of buzzers) to your students can be equally effective although somewhat more obnoxious.



Who Created the Course?

GREGORY T. MILLER
Associate Professor of Chemistry

Department of Chemistry
Southern Oregon University
Ashland, OR 97520
(541) 552-6408
millergr@sou.edu

Education

5/2000	PhD in Chemistry The University of Alabama, Tuscaloosa, AL Research Advisor: Prof. Russell Timkovich
5/94	B.S. Degree in Chemistry Northwestern State University of Louisiana, Natchitoches, LA

Professional Experience

9/99-present	Assistant Professor of Chemistry, Southern Oregon University, Department of Chemistry
1/98-8/98	Adjunct Instructor of Chemistry, The University of Alabama, Department of Chemistry
8/95-5/99	Instructor of Chemistry, The University of Alabama, College of Nursing and Center for Teaching and Learning

8/95-1/96 Interim Laboratory Coordinator, The University of Alabama, Department of Chemistry

8/94-5/96 Graduate Teaching Assistant, The University of Alabama, Department of Chemistry

8/93-5/94 Undergraduate Teaching Assistant, Northwestern State University of Louisiana, Department of Mathematical and Physical Sciences

Refereed Publications

1. Miller, G.T., Mackay, D.Q., Standley, M.S., Fields, S.L., Clary, W.M., and Timkovich, R. Expression of *Pseudomonas stutzeri* Zobell c-551 and its H47A variant in *Escherichia coli. Prot. Exp. Purif*., **2003**, 29, 244-251.

2. Miller, G.T., Hardman, J.K., and Timkovich, R. Solution conformation of the Met-61 to His-61 mutant of *Pseudomonas sutzeri* Zobell ferrocytochrome c-551. *Biophys. J.*, **2001**, *80*, 2928-2934.

3. Miller, G.T.; Zhang, B.; Hardman, J.K.; Timkovich, R.T. Converting a c-Type to a b-Type Cytochrome: the Met61 to His61 Mutant of *Pseudomonas* Cytochrome c-551*. Biochemistry,* **2000**, *39,* 9010-9017.

4. Carraway, A.; Miller, G.T.; Pearce, L.; Peterson, J. The Alkaline Transition of Bis(N-acetylated) Heme Undecapeptide. *Inorg. Chem.* **1998**, *37*, 4654-4661.

Professional Affiliations

American Chemical Society – Division of Chemical Education

American Chemical Society – Division of Biological Chemistry

Association of American Colleges and Universities – Associate Member

National Center for Science Education

Grants Received

National Science Foundation Major Research Instrumentation - 2001
$158,000 to establish a central modern biotechnology research facility at SOU

National Science Foundation Major Research Instrumentation - 2001
$293,000 toward the purchase of the Department's 400 MHz Bruker Avance NMR

M.J. Murdock Charitable Trust - 2002
$213,000 for equipment and instrumentation to complete the Biotechnology and Organic Spectroscopy Research Facilities

SOU Professional Development -2002
$6,650 for Biotechnology Research Facility supplies and consumables

Science Education for New Civic Engagements and Responsibilities (SENCER) – 2001
$3,500 Course Development and Conference Travel Award

Teaching roles and responsibilities at SOU

My primary teaching responsibilities at Southern Oregon University include our yearlong biochemistry course for majors (Ch 451-453) and lab (Ch 454-455), as well as, the *Forensic Investigation* class developed as our model SENCER course. Additionally, I teach in our general and organic chemistry laboratory sequences and I teach Introductory Chemistry for non-majors. I have also recently been involved in our Chemistry Information course and co-taught an evolution seminar class in the Biology Department.

Teaching goals and philosophy

Five years of teaching at Southern Oregon University has reinforced a belief I developed during my experience as a graduate teaching assistant and instructor at the University of Alabama: an effective teacher is different things to different students. Each student comes to me with a unique history, both academic and personal. This history influences the way an individual student approaches a subject, the way each student absorbs and processes course content, and, perhaps most importantly, the perception each student has regarding his or her academic ability.

As a faculty member in science, I see my objective being the same in both major's chemistry and general education courses. That objective is to make the material I cover accessible to my students regardless of whether the student in question is the brightest and most ambitious in my very competitive senior-level biochemistry lecture or the introductory chemistry student with a poor background in science. Teaching effectiveness, to me, is the ability to make course content accessible to every student by means discussed below. "Accessible" material, it is important to note, is not synonymous with "easy" and does not lessen the responsibilities of the student. On a similar note, *teaching effectiveness* and *student learning*, although inseparable, do not always go hand in hand. It is only when both instructor and student understand and commit to their individual roles in education that true learning can take place.

An effective teacher is one that is both interested in and knowledgeable about the subject matter. It is my hope that all teachers have an interest in the subjects they teach. Being knowledgeable in a discipline, however, requires time and dedication. Two of the courses I teach every year are biochemistry (Ch 451-453) and forensic science (Ch 300). Both are young sciences and the course material is evolving on a year-by-year basis. It is important that the lectures, assignments, demonstrations, laboratories, and exams change with the science. I try to evolve with my course by evaluating new textbooks, reading the literature, and staying active with my own research projects involving capstone students.

An effective teacher is one that is enthusiastic about the course and subject. Enthusiasm is contagious in a classroom. There are specific reasons why I chose chemistry and biology as career fields. There are exciting and society-altering discoveries made each week. There are unanswered questions to investigate and future questions that, as yet, have not been posed. I try and share the "discovery" aspects of science with my students.

An effective teacher is one that is available to his or her students. I encourage students to come see me in my office and, literally, never close my office door. Students need to be able to communicate with their professors and not just about yesterday's lecture or next week's test but about next year's hurdles or life after college. Students have questions about their future; who better to help them find answers than those of us that have previously sought similar advice?

Research and other activities

Along with great aid from my students, I am currently active in three different research projects. I have also been fortunate to serve as research mentor to 10 senior chemistry or biochemistry majors in the five years I have been at SOU.

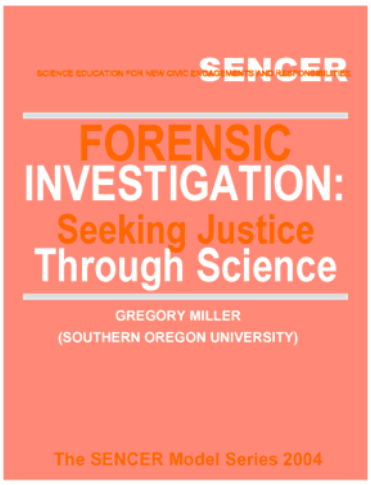
Our first research project is an investigation of conserved amino acid residues in the bacterial cytochrome c-551 isolated from *Pseudomonas*. We are currently studying the third of five site-specific mutants generated to better understand structure-function relationships in this class of electron transport protein.

Our second area of research involves the cloning and expression of synthetic genes coding for *Conus* (Cone snail) peptide toxins. These toxins are being heterologously expressed in *E. coli*. Evolution has created peptide toxins with great specificity for cellular receptors. We are looking at *E. coli* as a cost effective and rapid way to produce these peptides, which can be used as models for future pharmaceuticals.

Finally, our research group is looking to characterize the venom of the Western ringneck snake (*Diadophis punctatus*). There have been conflicting reports in the literature as to whether this species is venomous. As one of the most common

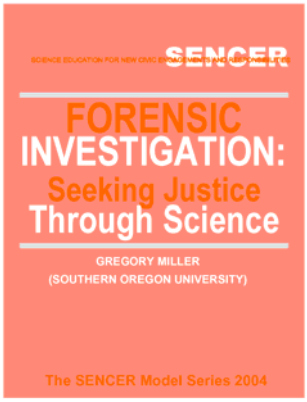
snakes in southern Oregon, there clearly exists an opportunity to expand our knowledge in this area.

Aside from my teaching and research responsibilities, I am heavily committed to science education for K-12 students (ACS – Division of Chemical Education, ACS Kids and Chemistry, and Project Kaleidoscope) and aiding SOU in the recruitment of high-caliber science undergraduates.



Where is *Forensic Investigation* Taught?

Southern Oregon University is the premier academic resource for southern Oregon and neighboring counties in California. Enrolling 5000 undergraduates and 500 graduate students in 35 degree granting programs, it is distinctive among Oregon's institutions of higher learning. The 175-acre campus sits at the crux of the Siskiyou, Western Coastal, and Cascade Mountain ranges and within a two hours drive of three national parks, 5 “wild and scenic” rivers, the tropical Pacific coast, and the arid conditions of the Eastern Oregon deserts. The University aspires to enhance its contribution to the region and Oregon by positioning itself as one of America's finest contemporary public liberal arts universities. Recently inducted into the Council of Public Liberal Arts Colleges (COPLAC), the University is well on its way to realizing its vision of being regionally responsive and nationally recognized.



What is the Course's Role in the Undergraduate Curriculum?

Over the past several years, SOU has, in stages, revised its General Education program. The guiding principles for SOU's General Education Program are closely aligned with the SENCER philosophy. Specifically, the last sentence of the following paragraph addresses inclusion of problem-based material and case histories in the courses. SOU is especially interested in utilizing the SENCER approach and our involvement in the workshops to develop new, upper division Synthesis courses (See Item IIA, below) and to improve our assessment of both the Explorations and Synthesis components of our general education program.

Forensic Investigation is a Synthesis and Application course. This class, although commonly taken by biology and chemistry majors (especially those with an interest in forensic science), does not count towards a major or minor in any of our academic disciplines.

"The purpose of general education at Southern Oregon University is to nurture a commitment to sustained learning that encourages students to question assumptions, to reason critically, and to synthesize ideas from many different realms of knowledge and intellectual endeavor. To prepare students for active and responsible participation in their personal and public lives, general education courses develop critical and creative thinking, effective communication, literacy, and adaptability. Courses develop a student's ability to arrive at thoughtful and informed judgments by exploring ways in which individuals, communities, and cultures have confronted and imagined the problems and possibilities of existence. The learning objectives for the science component (see below) include hands-on opportunities for students.

Guiding Principles:

1. General education at SOU should reinforce critical and creative thinking, effective communication, literacy, and adaptability throughout a student's entire college experience.
2. General education at SOU should consist of both common experiences shared by all students and similar experiences specifically designed for students in different majors.
3. General education at SOU should contain a significant component that is interdisciplinary in nature and focused on relationships among disciplines.
4. General education at SOU should contain a significant component that

is multicultural and international in nature.

5. General education at SOU should provide a guided tour (an overview) of various disciplines including examples from the arts and humanities, the sciences, and the social sciences.
6. General education at SOU should provide each student with significant depth in several different disciplines.
7. General education at SOU should provide all upper division students with an opportunity to interact, in an academic setting, with students from a wide variety of disciplines."

The current General Education program consists of the following components (Total quarter credits are at least 45, but are most likely to range between 48 and 52):

I. Lower division:

A. University Colloquium: An innovative, year-long course for first year students which emphasizes critical thinking, problem solving, and communication skills.

The program focuses on the critical skills necessary for university students to become a part of a thriving intellectual and social community. Faculty serve as both instructors and advisers during the first year, unless the student has already chosen a major. Class sizes are limited to 24 students. Several "enrichment" sections are offered for those students seeking a faster-paced and more in-depth experience around ethical issues. The course is structured so that students keep the same meeting time and instructor for the entire academic year. All students are engaged in a common curriculum, and yet, because of inevitable differences among the students and the faculty, different sections experience it in a variety of ways. All sections apply common standards, pursue common outcomes, and include similar assignments and experiences.

B. Explorations: Lower-division sequences: Two course sequences from each of Arts and Letters, Science, and Social Science and one course in Quantitative Reasoning.

These courses provide students with an understanding of the ways of knowing common to disciplines within the school area, and the ways in which those disciplines help us to understand the problems and concerns of our lives. Coursework from any department may be incorporated into any sequence as long as it fully addresses the relevant School-area based learning objectives. Sequences could be developed around a topic or theme, and incorporate perspectives and faculty from multiple disciplines, including Business. The Quantitative Reasoning requirement may be satisfied by completion of either a stand-alone course or by completion of an Explorations sequence that

incorporates the quantitative reasoning learning objectives.

All of the Explorations sequences must do the following: (1) Develop in a significant way all of the School-area based learning objectives, (2). Provide an opportunity for students to demonstrate their proficiency with these goals, (3). Reinforce academic skills of critical reading, reasoning, written and oral communication, and (4). Contain pedagogy geared toward active learning.

The learning objectives that are applied to Explorations sequences in Science and to the Quantitative Reasoning courses are as follows:

Science:

- Understand the interaction between science, technology, ethics, and other human affairs.
- Correctly use the language and concepts of more than one science discipline and appreciate connections between individual disciplines.
- Explore the use of science as a means of communicating unambiguously about the physical world.
- Use the following methods of observational and experimental science as appropriate: generate and test hypotheses, make observations, design and carry out experiments in a laboratory or field setting, use appropriate tools (including mathematics) to analyze results, recognize limitations of equipment used, communicate experimental results.
- Make informed decisions on scientific questions based on reason rather than authority by differentiating real from pseudo science, evaluating sources of information, understanding the domain and limitations of scientific inquiry, reading critically in science, and drawing conclusions based on scientific evidence.

Quantitative Reasoning:

- Use mathematical symbols to represent real-world phenomena, answer questions based on linear and non-linear mathematical relationships, and express mathematical statements in plain language.
- Understand the logical distinction between facts, assumptions, and conclusions, and demonstrate the ability to move from facts or assumptions to mathematically valid conclusions.
- Create appropriate visual displays of data, compute appropriate summary measures (e.g. mean, variance, or trend), and recognize numerically implausible data or conclusions.

II. Upper division:

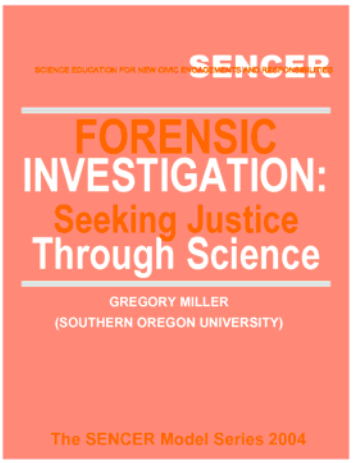
A. Synthesis and Application: Upper-division interdisciplinary courses, one from each of Arts and Letters, Science, and Social Science.

These courses emphasize the ways in which multiple disciplinary

perspectives illuminate different facets of understanding. They assume more intellectual maturity of students, and permit greater depth of study than is the case with the lower-division "explorations" sequences. Synthesis courses build on the foundation laid in the Colloquium and the explorations sequences to reinforce students' written and oral communication, critical reading, and reasoning abilities. Synthesis courses might be interdisciplinary (or multidisciplinary) within one of the three school areas, but preferably are multi-school. Any of these courses could also include a business component. Faculty from all involved disciplines often collaborate in course planning or instruction.

B. Capstone Experience:

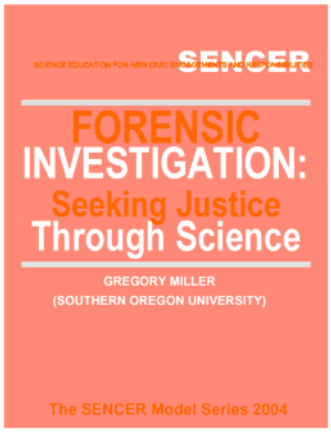
Though not strictly part of General Education at SOU, a Capstone Experience, which is designed to bring focus to and provide richer understanding of the major field of study, is a required component of all undergraduate degree programs. In most of the Science programs and Environmental Studies, the capstone is a team or individual research project related to the student's field. Usually, the final stage of the capstone project is an oral presentation of professional caliber.



Assessment and Evaluation

Student assessment in the *Forensic Investigation* course is based on two mid-term exams and one comprehensive final examination. Students are also graded on their research paper or case study portfolio. Currently, there is no verbal communication aspect to the course. Those students that have the opportunity to enroll in the optional laboratory are also assessed based on their written lab reports (including their final report where they make a written case for the guilt of their suspect). These students are also evaluated on the presentation of their forensic findings. These presentations are given before the class with all other members serving as the jury for our mock crime scenarios.

The effectiveness of the course and instructor are gauged using Southern Oregon University's evaluation tool, as well as, the online SALG tool developed for just such a purpose (to gauge how students feel they have progressed in certain areas).



Conclusions, Developments, Observations, Recognition for Course

The *Forensic Investigation* course has become one of the most popular courses offered at our University. Almost unfortunately, this class fills on the first day of registration. Students comment favorably on the use of demos and the PRS often claiming the class always kept their attention. Based on the success of this class, SOU is now offering two additional Synthesis and Application classes offered around a forensics based theme: a Computer Forensics class (CS 346) and a Criminal Investigations course in our Criminology Department (Cr 407). The first allows basic principles of computer science to be introduced as students learn about cyber crime, the fastest growing category of crime in the U.S. The second teaches students the introductory aspects of criminology including scene preservation and detective work through a crime-based class.

It can be hoped that other instructors at SOU will look at *Forensic Investigation* as a model course for capturing student attention. The students who have taken *Forensics* become the biggest advocates for the class. It is satisfying that these students recommend the class not only for what the course teaches, but also they way in which the course is taught.

Addendum to Forensic Investigation

The most recent change to the course involves forensics students designing and implementing plans through which they help lessen crime in Southern Oregon community. This is an assignment that students work on in teams and have the entire term to complete. Students have worked with local police departments, helped organize neighborhood watches, and printed literature for parents on keeping kids safe (from strangers, drugs, alcohol, etc). They are charged with designing a plan to make a difference in the community, implementing the plan, and summarizing their idea in a written paper where they discuss strengths and weaknesses of their idea and can offer a budget for continued success.

In the summer and fall of 2005, select members of the class have volunteered with the Tommy Foundation (local chapter of the National Center for Missing and Exploited Children). These students have helped fingerprint children in the community at the parent's request using digital software. The students also help make parents aware of what to do if a child should go missing including distribution of packets of literature, educating people on the Amber Alert system, and handing out kits designed to help parents save children's DNA for comparison to evidence. Our next event is Saturday, August 6, at Hawthorne Park in Medford, OR, and is co-sponsored by a local television station and the Tommy Foundation.

http://www.tommyfoundation.org/