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Executive Summary

The Interdisciplinary Graduate Program in Environmental Sciences (ES) was established in 1994. The ES program has developed into a successful program focused on environmental processes (with an emphasis on analytical chemistry), and environmental health (with an emphasis on biochemical and cellular toxicology). ES provides access to Doctoral students for faculty in departments and research units in which no Ph.D. program is available, for example: the Department of Natural Resources and Environmental Science (NRES) (College of Agriculture, Biotechnology and Natural Resources (CABNR)), the Nutrition Department (CABNR), the School of Public Health (College of Health and Human Sciences); the Department of Animal Biotechnology (CABNR), and the Desert Research Institute. The ES graduate program is one of five similar programs in the western United States (see text for a list of others) that offer M.S. and Ph.D. degrees. It is unique in that much of the research focuses on local and regional environmental concerns.

Program Emphasis

ES programatic emphasis is chemical fate and transport, as well as how these chemicals affect humans, plants and animals. The ES program recognizes that environmental science is driven by risk perception and assessment and ultimately how risk can be reduced through environmental laws and regulations. The program focuses on mechanisms of action of toxic substances. Accordingly, the ES program has a strong basis in quantitative science, and currently requires that students have completed course work and have experience with chemistry, biology, mathematics and physics.

ES offers MS and doctoral degrees in the two tracks of environmental processes and environmental health. Each track has a leader, currently Dr. Stanley Omaye (Environmental Health) and Dr. Glenn Miller (Environmental Processes). Twenty three full-time graduate students are enrolled in ES, with 11 Masters degree candidates and 12 doctoral candidates. The ethnicity of the ES student from 2000—2006 was primarily Caucasian (66%), with 2% Asian/Pacific Islander, 18% international students (for example from Jordan, China and Chile) and 14% of unknown ethnicity. Graduates with M.S. and Ph.D. degrees have been predominantly female in the past seven years (2000—2006, with 20/30 M.S. degrees and 14/21 Ph.D. degrees awarded to females).
Mission and Objectives
The ES program’s mission is to be a competitive and strong interdisciplinary graduate program in Environmental Sciences in the western United States. The program prepares graduate students for challenging positions in academia, government and private industry to recognize environmental hazards, to protect human health and to improve environmental quality. Associated objectives include:

- Working with a variety of departmental and interdisciplinary programs,
- Maximizing educational and research opportunities for graduate students,
- Maintaining an active and involved faculty who participate in the program, particularly in critical program areas;
- Improving the administration of the ES graduate program;
- Providing graduate students with the tools necessary for excelling in graduate school;
- Promoting the internal and external visibility of the program and
- Increasing and maintaining enrollment at 35-45 graduate students.

Management of ES Program
Internal management of the ES program is primarily the responsibility of the program director. The program director relies upon ad-hoc committees for all major issues such as curriculum, examination procedures, and course offerings. Student advisement is a joint responsibility of the faculty advisor and student graduate committee with the bulk of the responsibility handled by the faculty advisor.

The program allows students to design a curriculum to meet disciplinary interests and professional aspirations. All requirements of the ES program are based upon the requirements for graduate study, specified by the University of Nevada, Reno General Catalog. The ES faculty evaluates and approves graduate courses in the ES course listing and determines the structure of the core curriculum. Because ES is an interdisciplinary program with no faculty of its own, its courses are taught by faculty from participating departments. Courses that are developed solely for ES would require faculty release time from departmental teaching commitments.

Student plans of study are developed individually upon consultation with the faculty advisor and graduate committee members. The director of the program reviews and approves plans of study, changes in programs of study, committee membership and completion forms at the close of a student’s tenure in the ES program. In addition, the ES program provides guidelines for oral presentation of Ph.D. research proposals and oral and written exams.
Faculty
There are 26 graduate faculty in ES, with 11 actively advising one or more graduate students within the last year. The ES maintains faculty based on their level of involvement in the program. The ES does not have specific requirements for graduate faculty status, but rather defaults to those of the University of Nevada Graduate School. Faculty wishing to be admitted to the program must meet several requirements, including presenting a seminar about their research as part of the ES Fall or Spring seminar series and, following circulation of their resume and a letter of intent, approval of admission by ES faculty by simple majority. Graduate School policy allows faculty employed by UNR and DRI to serve in all capacities of graduate education in ES. Faculty from the U.S. Geological Survey and other organizations have only the restriction of co-chairing student committees rather than chairing committees independently. Because the ES graduate program is dependent on faculty from various departments and divisions on campus and at DRI, the program has limited input in faculty search criteria, including qualifications and expectations for course offerings.

The program recently added four faculty, from the University of Nevada’s School of Public Health (two) and the Desert Research Institute Division of Atmospheric Sciences (two). Although more faculty participation is useful, it is important that the ES program carefully consider program needs to guide recruitment of faculty and students. Given recent decreases in student enrollment it is important that the program work with existing faculty to attract students from institutions with environmental science B.S. and M.S. programs. Also, it will be important to work with departments at the University of Nevada and the Desert Research Institute to hire new faculty to fill critical needs for the program.

The recent creation of a university-wide environmental institute (the Academy for the Environment) offers an opportunity to modify the current reporting relationship of the ES in ways that will provide increased opportunities for growth and development. It is not clear at this time when this proposal will be considered accepted or rejected by the administrative home of the ES program, the University of Nevada’s Graduate School.
ES students are primarily supported as research assistants. A limited number of teaching assistantships is supported by the University of Nevada Graduate School and participating departments.

ES relies upon the cooperation of departments and units for its entire academic program. The majority of graduate courses are offered through the departments of Natural Resource and Environmental Science (NRES), Nutrition, Civil and Environmental Engineering, Biology, the School of Public Health and the interdisciplinary Atmospheric Sciences program. ES hires short-term instructional faculty on a letter of appointment basis to teach courses. Although the use of these has been sparing, we plan to develop courses that may become part of the core on an exploratory basis with the help of such faculty. The current arrangement leads to fragmentation and incomplete control over course content, including development and continuance of courses that meet student needs. The University offers a limited number of 700 level courses that meet the requirement for completion of graduate studies. In addition, there is no formal mechanism to ensure that new course offerings meet the needs of students in the program. One potential remedy for this is to establish and maintain good communication with chairs of departments that have faculty participating in the ES program.

Over the past seven years, cumulative awards to faculty members in the program total $85 million, in 566 grants and contracts. However, no formal accounting procedure exists to differentiate between funds awarded to ES faculty members to support ES students and research and funds awarded for other purposes.

The strengths of the program include:
- Interdisciplinary involvement for faculty and students
- Doctoral level research opportunities
- Recognition as a regional leader in environmental sciences
- Ongoing support from the Graduate School.

The challenges of the program include:
- Unclear program identity
- Faculty involvement with respect to departmental and research unit expectations
- Faculty involvement with respect to program ownership
- Student involvement with program administration and management
- Declining enrollment
- Lack of a physical center.
The following changes are meant to address two critical issues: increase student enrollment and clarify program identity. These include:

- Establishing a program steering committee in accordance with the original bylaws,
- Establishing a program advisory committee in accordance with the original bylaws,
- Involving students in program design and governance in accordance with the original bylaws,
- Focusing recruitment efforts for students,
- Defining a thematic focus,
- Tracking student employment,
- Evaluating faculty participation,
- Tracking grant and contract success,
- Establishing new courses to promote student success and program cohesiveness and
- Increasing competition for training grants to support graduate students and enhance program visibility.
**Part I**  
Program History, Mission, and Administrative Structure

**Program History**

The Interdisciplinary Graduate Program in Environmental Sciences (ES) was established in 1994 as a Ph.D. and thesis Master’s degree program. The ES program has developed into a successful program that is focused on environmental processes and environmental health. The program has 26 graduate faculty from the Colleges of Agriculture, Biotechnology and Natural Resources, Health and Human Sciences, Science and Engineering and the Desert Research Institute (DRI) and the U.S. Geological Survey. Currently, there are 23 full time graduate students enrolled in ES, with 11 Masters students and 12 doctoral candidates. Of the 26 graduate faculty in ES, 11 advised one or more graduate students within the last year.

The ES program has changed substantially in the past seven years, primarily in response to suggestions and interests of faculty. The program initially offered four tracks within the M.S. and Ph.D. programs. However, the tracks presented significant challenges with respect to specifying a common programmatic core curriculum and maintaining an adequate number of faculty participants. By consensus, participating ES faculty agreed to reduce the number of tracks to two (Environmental Processes and Environmental Health) in Spring, 2006. The change provides the program with an identity that is more easily maintained than the previous offering of four tracks.

**Mission and Objectives of the ES Program**

The program mission statement included in the Strategic Plan developed in 2003 (Appendix K) is to “develop the strongest interdisciplinary graduate program in Environmental Sciences in the western United States and prepare graduate students for challenging positions in academia, government and private industry to protect human health and improve environmental quality.”

**Objectives include:**

- Working with a variety of departmental and interdisciplinary programs,
- Maximizing educational and research opportunities for graduate students,
- Maintaining an active and involved faculty who participate in the program, particularly in critical program areas;
- Improving the administration of the ES graduate program;
- Providing graduate students with the tools necessary for excelling in graduate school;
- Promoting the internal and external visibility of the program; and
- Increasing and maintaining enrollment at 35-45 graduate students.
The ES program’s goals and objectives correspond closely with the University’s goals and objectives. The University of Nevada’s Strategic Plan lists five goals: EDUCATE, EXPLORE, ENGAGE, ENABLE and ENHANCE. Objectives associated with each goal are listed below. Those with which the ES program is closely aligned are shown in bold:

**EDUCATE**
1. Expand undergraduate involvement in scholarly activities
2. Develop and use assessment instruments
3. Strengthen the core undergraduate curriculum
4. Enhance graduate education

**EXPLORE**
5. Recruit and retain high-quality scholars
6. Target a select number of signature areas

**ENGAGE**
7. Make the university more accessible to community
8. Assist in meeting state needs
9. Increase faculty participation in outreach activities

**ENABLE**
10. Provide and maintain necessary technology
11. Maintain, efficiently organize, and expand our physical spaces
12. Streamline administrative functions
13. Develop the University Libraries
14. Improve the visibility and profile of the university

**ENHANCE**
15. Foster a culture that embraces diversity
16. Build more residential communities
17. Promote participation in more co-curricular learning opportunities
18. Improve student communication and orientation
19. Improve working conditions for faculty and staff
20. Enhance campus safety
21. Improve access to advising services
Administrative Structure

The ES relies upon the cooperation of departments and units for its entire academic program. The majority of graduate courses are offered through the departments of Natural Resource and Environmental Science (NRES), Civil Engineering, Biochemistry, Nutrition, Biology and Atmospheric Sciences. Because the program is interdisciplinary, faculty are from the following areas:

- the College of Agriculture, Biotechnology and Natural Resources
- the College of Engineering
- the College of Health and Human Sciences and
- the Desert Research Institute
- the U.S. Geological Survey.

The ES program is currently administered by the Dean of the Graduate School. The Graduate School provides an annual budget for graduate student support and program administration. Courses are offered through departments. The Graduate School provides the home department of the program director with an annual evaluation, which may be used to allocate merit pay for the director. The program bylaws (Appendix L), developed in 1994, specify an administrative structure that consists of formal management (the Program Director, with oversight responsibilities by the University of Nevada Graduate School) and informal operation (standing and ad hoc committees). Internal management of the ES program is primarily the responsibility of the Program Director. The program director relies upon ad-hoc committees for all major issues including curriculum, examination procedures, and course offerings. Reliance on ad-hoc committees results from the interdisciplinary nature of the program and the competition for faculty time with departmental responsibilities (where merit and annual evaluation are conducted). The director assigns a small faculty group to examine an issue, and report back to the entire faculty at a faculty meeting and/or by electronic voting.

The ES program has not undergone a program review recently. Recent changes (for example, reduction of number of tracks in the program) have been suggested by participating faculty to reflect ongoing discussions about the program, including program identity and viability of individual tracks.

ES provides access to Doctoral students for faculty in departments and research units in which no Ph.D. program is available
The recent creation of a university-wide environmental institute (i.e., the Academy for the Environment) offers an opportunity to modify the current administrative relationship. Specifically, the ES program would report to the Graduate School through the Academy for the Environment. This new administrative relationship could enhance ES, especially with respect to visibility and fiscal and human resources. The Academy could function as the advocate for ES, including representing the programs to the upper administration in the university. The Academy would provide coordination and assistance with respect to graduate student recruitment and retention, curriculum development, program assessment, financial management, development, and other activities. This arrangement has not been formalized, though three other interdisciplinary programs that would also be administered by the Academy (Ecology, Evolution and Conservation Biology, Atmospheric Sciences, and Hydrologic Sciences) are not in favor of this proposal. In Spring, 2007 ES faculty approved the proposed administrative arrangement. It is not clear at this time when this proposal will be considered accepted or rejected by the Graduate School.

The University of Nevada is a land-grant institution in Reno, Nevada. Land-grant colleges or universities have been designated by the state legislature or Congress to receive the benefits of the Morrill Acts of 1862 and 1890. The original mission of these institutions, as set forth in the first Morrill Act, was to teach agriculture, military tactics, and the mechanic arts as well as classical studies so that members of the working classes could obtain a liberal, practical education. Passage of the First Morrill Act (1862) reflected a growing demand for agricultural and technical education in the United States. While a number of institutions had begun to expand upon the traditional classical curriculum, higher education was still widely unavailable to many agricultural and industrial workers. The Morrill Act was intended to provide a broad segment of the population with a practical education that had direct relevance to their daily lives.
Part II
Courses and Degree Programs

Graduate Program Organization, Objectives and Effectiveness

Admission Standards and Application Content
The ES program admits students in the Spring and Fall semesters. Applications are submitted on-line to the University of Nevada Graduate School, which maintains a database of scanned materials accessible through the NOLIJ system. The following criteria must be met for consideration of applications:

- The Master's program requires an undergraduate GPA of 3.0
- The Ph.D. program requires a minimum GPA of 3.0
- GRE greater than 500 each for verbal and quantitative
- TOEFL score must exceed 600 for international students

The application requires:
- 3 letters of recommendation
- A letter of intent addressed to the Director of the program that describes academic goals, choice of disciplinary track, and research interests, and
- Documentation from an ES faculty member who agrees to be a research advisor.

Research and Societal Needs
The development of the ES program occurred as a response to wide interest in the environmental sciences from faculty members at UNR and DRI. As indicated by the two track areas (environmental processes and environmental health), ES considers how chemicals move and are transformed in the environment, as well as how these chemicals affect humans, plants and animals. The ES program recognizes that environmental science is driven by risk assessment, and ultimately, how risk can be reduced through environmental laws and regulations. The societal response to these risks considers the magnitude of the risk, and must be placed in context with other risks and priorities. The ES program, similar to other academic environmental science programs in the U.S., seeks to conduct research and educate students in techniques to determine risk by better understanding how chemicals and chemical transport processes could affect various forms of life.
Analysis of Course Selection and Methodologies of Curriculum Development
The general area of environmental studies is broad and includes classical disciplines. The ES program has a foundation in quantitative science, and requires that applicants have a background in chemistry, biology, mathematics and physics. The program allows students to design a curriculum to meet disciplinary interests and professional aspirations. All requirements of the ES program are based upon the requirements for graduate study specified by the University of Nevada, Reno General Catalog. The degrees and requirements for degrees are designed by the faculty of ES and must meet or exceed those required by the Graduate School. The ES program is responsible for admissions requirements, applicant review and student orientation. The ES faculty evaluates and approves graduate courses in the ES course listing and determines the core curriculum (see p. 13). Because ES is an interdisciplinary program with no faculty of its own, its courses are taught by faculty from other departments. Courses that are developed solely for ES would require faculty release time from departmental teaching commitments. This has been possible to date, but some semesters have few 700 level courses from which to choose. Plans of study are developed individually upon consultation with the faculty advisor and graduate committee members.

ES offers MS and doctoral degrees in two tracks: Environmental Processes and Environmental Health, each of which is described below. Each track has a leader – Dr. Stanley Omaye (Department of Nutrition–College of Agriculture, Biotechnology and Natural Resources) is the leader for Environmental Health and Dr. Glenn Miller (Department of Natural Resources and Environmental Sciences–College of Agriculture, Biotechnology and Natural Resources) is the track leader for Environmental Processes. Each track is described briefly below.

Environmental Processes:
Environmental processes and analytical chemistry are the primary focus of this track. Students work on research projects, which range from determining methods of remediation of acid mine drainage, to determining long range transport of trace contaminants in air. Students need to have a fundamentally sound understanding of physical chemical processes and advanced instrumentation for measurement of trace contaminants.

Dr. Glenn Miller, former director of the Environmental Sciences Graduate Program, continues research with acid mine drainage and biofuel production. Dr. Miller is the leader of the Environmental Processes track.
Environmental Health:
Biochemical and cellular toxicology and effects of environmental pollutants on human health are the focus of this track. Special emphasis is placed on the impact of contaminants on humans. Examples of projects covered in this area include response of tissues to oxidative stress, impacts of selenium on developing embryos and the effects of indoor and outdoor air contaminants, and environmental metals (such as arsenic, mercury, and lead). Students rely on a strong background in biochemistry and cellular biology. This track also includes the disciplines of wildlife toxicology and conservation biology, with a goal of understanding how a variety of contaminants affect populations and ecosystems. Projects include determining the effect of low doses of pesticide on cyanide on migratory waterfowl, the effect of rising carbon dioxide on plants, and how wetlands are affected by contaminants. For this particular focus, students require training in organismal level biology, toxicology and chemistry.

Research committees for graduate work:
For a master’s degree committee, the major professor (Chair) and one other member must be from the program. A Graduate School representative must be from outside of the ES program. The Graduate School representative does not have to be familiar with what the subject of research. All committee members must be a part of University of Nevada’s Graduate Faculty. For a doctoral degree, at the completion of twelve graduate credits, the student selects a committee chair and the student and chair arrange the appointment of four additional members. The committee and the director of the Environmental Sciences program supervise the student’s course of study and examinations.

For doctoral studies:
In addition to the Committee Chair, at least two members are from the student’s mentor’s department, at least one will be from a department in a field related to the student’s major, and at least one will be a Graduate School representative from the graduate faculty. Students may request the appointment of a committee member from the faculty of another university or from a relevant discipline or profession, provided the prospective member has achieved a record of distinction. The Graduate Dean formally approves a student’s advisory/examining committee.

Core Curriculum:
Students in the Environmental Processes and Environmental Health tracks must complete a core of courses, shown on page 13. These provide a comprehensive background in subject matter important for these tracks. Because of overlap between the lists of choices for each track, it is possible for students to have similar or completely different core course work, regardless of track.
In addition, all students must complete one graduate course in statistics (for example, ATMS 706; APST 463/663, 470/670, 705, 755; STAT 452/652, 755, 757, 758) and enroll in the Environmental Science Program’s Seminar Series (NRES 790—3 credits for Master’s and 4 credits for Ph.D.).

Core for Environmental Health:
Biochemistry (BCH 600), and 3 of the following 8 courses:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Title</th>
<th>No. Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRES 632</td>
<td>Environmental Toxicology</td>
<td>3</td>
</tr>
<tr>
<td>NRES 630</td>
<td>Analysis of Environmental Contaminants</td>
<td>3</td>
</tr>
<tr>
<td>NRES 633</td>
<td>Environmental Chemicals</td>
<td>3</td>
</tr>
<tr>
<td>NUTR 728</td>
<td>Food and Nutritional Toxicology</td>
<td>3</td>
</tr>
<tr>
<td>PUBH 673</td>
<td>Epidemiology</td>
<td>3</td>
</tr>
<tr>
<td>PUBH 780</td>
<td>Biostatistics</td>
<td>3</td>
</tr>
<tr>
<td>CEE 756</td>
<td>Aquatic Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 620</td>
<td>Aquatic Ecology</td>
<td>3</td>
</tr>
</tbody>
</table>

Environmental Processes:
4 of the 8 following classes:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Title</th>
<th>No. Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRES 765</td>
<td>Biogeochemical Cycles</td>
<td>3</td>
</tr>
<tr>
<td>BCH 600</td>
<td>Biochemistry</td>
<td>4</td>
</tr>
<tr>
<td>NRES 632</td>
<td>Environmental Toxicology</td>
<td>3</td>
</tr>
<tr>
<td>NRES 630</td>
<td>Analysis of Environmental Contaminants</td>
<td>3</td>
</tr>
<tr>
<td>NRES 633</td>
<td>Environmental Chemicals</td>
<td>3</td>
</tr>
<tr>
<td>CEE 756</td>
<td>Aquatic Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>ATMS 747</td>
<td>Atmospheric Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>ATMS 612</td>
<td>Air Pollution</td>
<td>3</td>
</tr>
</tbody>
</table>

Additional Core Requirements
In addition to the Core courses listed above, all ES students enroll in:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Title</th>
<th>No. Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRES 790</td>
<td>Seminar</td>
<td>3-4</td>
</tr>
<tr>
<td>### 797*</td>
<td>Thesis (MS)</td>
<td>6</td>
</tr>
<tr>
<td>### 799*</td>
<td>Dissertation (Ph.D.)</td>
<td>24</td>
</tr>
</tbody>
</table>

*Thesis credits for MS and PhD students have prefixes that reflect the home departments of students.

A description of these and other courses taken by ES students and their descriptions can be found in Appendix A.
Elective Courses
Each student's program of study is based on the disciplinary track she/he has chosen. Elective courses may be selected from a variety of departments, including but not limited to:

- Applied Statistics (APST)
- Atmospheric Sciences (ATMS)
- Biochemistry (BCH)
- Biology (BIOL)
- Cell and Molecular Biology (CMB)
- Chemical Engineering (CHE)
- Chemistry (CHEM)
- Civil and Environmental Engineering (CEE)
- Geography (GEOG)
- Geology (GEOL)
- Mathematics (MATH)
- Microbiology (MICRO)
- Natural Resources and Environmental Sciences (NRES)
- Nutrition (NUTR)
- Public Health (PUBH)
- Statistics (STAT)

A listing of elective courses taken by ES students since 2000 and their descriptions can be found in Appendix A.

Upon admission to ES and prior to beginning classes, students and their faculty advisors design the program for the first year. By the conclusion of the first year, the student's advisory committee collaborates on the rest of the program of study. The MS student’s program of study must include at least 30 credits, and a Ph.D. student’s program of study must include at least 72.

Comprehensive Examination for Admission to Doctoral Candidacy
Students enrolled in the doctoral program are admitted to doctoral candidacy after successful completion of a comprehensive written examination and an oral examination, each of which is described below.

Written Examination:
The written examination is comprehensive and tests general knowledge of subjects specified by members of the student’s committee. The subjects of questions are in the general area of the student’s courses and program. The examination consists of 5-7 questions. For purposes of consistency, the program director approves each written examination at least one week prior to administration of the exam. The examination is closed book and must be completed within an 8-hour period, which is proctored by the student’s committee chair.
The following provide examples of how the exams are structured.

- A student studying phosphorus sediment at Lake Tahoe might be expected to understand spectroscopic methods, sorption processes, effects of nutrients on watersheds, soil chemistry and the basis for regulatory actions regarding nutrients.
- A student studying gas exchange in plants might be expected to understand atmospheric measurement processes, plant physiology, soil-plant relationships, and global warming issues and impacts.
- A student focused on environmental health might be expected to understand epidemiology, toxicology, biochemistry and environmental contaminants that affect human health.

Oral Examination:
The oral examination is focused on the student's knowledge of the specific area of research, and involves presentation of no more than 13 research slides. Questions from committee members are generally in the specific area of research and designed to determine (1) how well the student understands their proposed research and (2) their ability to conduct research.

Lake Tahoe, a high alpine lake in the Sierra Mountains, lies on the border of California and Nevada. Efforts by faculty from the Environmental Sciences Graduate Program have focused on preserving the remarkable clarity of the lake by understanding and managing potential sources of pollutants.
Advising, Mentoring, Student Governance Procedures

Faculty in the ES program are first and foremost members of departments or organizations that ultimately set policies for managing graduate students. However, the ES program is responsible for setting academic standards for:

1) admission to the program,
2) development of programs of study, including formal coursework, independent study and internships,
3) conduct of research,
4) enforcement of policies related to academic integrity,
5) examination of doctoral students for admission to candidacy (both written and oral examinations), and
6) completion of theses and dissertations, including oral defense of the research.

Because graduate student research is primarily committee-driven and supervised, much of the responsibility for items 2, 3, 5 and 6 lies with members of a student’s M.S. and Ph.D. committees, led by the committee chair. The program does not prescribe specific management steps for students beyond expectations for average time to completion of development of plans of study, research and defense of research. The program has core requirements for each of the two tracks (Environmental Processes and Environmental Health), which are stated in the section on Research and Societal Needs (p. 10) of this document and on the program web site (www.unr.edu/idgrad/esh/). Beyond these core expectations, students and committee members are free to design programs of study that best enhance a student’s overall understanding of the subject matter related to the track and to successfully complete research that the student will carry out. The director of the program reviews and approves plans of study, changes in programs of study and committee membership and signs completion forms at the close of a student’s tenure in the ES program. In addition, the ES program provides guidelines for oral presentation of Ph.D. research proposals.

Scot Ferguson is a research technician working with Dr. Bob Nowak on the free air carbon-dioxide enrichment facility in southern Nevada.
Number of Faculty and Students in Program

There are 23 students in the program advised by 11 of the 26 ES faculty members. A list of active ES students with their advisors and contact information is found in Appendix J. Figure 1 shows the distribution of students by their advisor’s department. A large percentage of these students is scheduled to complete their program by December of 2007.

Figure 1. Distribution of ES students by advisor’s department.
Student Learning Outcomes

The Student-Learning Outcome Assessment Plan is found in Appendix B. Currently, the plan is not in use. We anticipate that a committee of ES faculty will use assessments to develop recommendations for changes or additions to course content, curriculum requirements, student recruitment and advisement. The committee will present their summary and recommendations to the ES graduate faculty for discussion and action. The ES faculty will also be asked to review and approve a plan for future assessment activities.

Figure 2 shows the time to completion of both the masters and doctoral degrees from 2002-2006. The average time to complete a M.S. program was slightly more than 2 ½ years (range 1—4 years). The average time to complete a Ph.D. program was 5 ¼ years (range 3—6 years).
Graduate Students

Degree Overviews
As of the Spring 2007 semester 11 masters and 12 doctoral students were enrolled in the program. Appendix J includes information about these students and their advisors.

Figure 4: Fall enrollment of ES students 2000-2006. The total number of students in the ES program reached 32 in 2000.

Figure 5 shows the gender distribution of students in the program from 2001-2006. Graduates with M.S. and Ph.D. degrees have been predominantly female in the past seven years (2000—2006, with 20/30 M.S. degrees and 14/21 Ph.D. degrees awarded to females).

Figure 5: Gender distribution of students in the program from 2001-2006.
Figure 6 shows the ethnicity of the ES student from 2000—2006 was primarily Caucasian (66%), with 2% Asian/Pacific Islander, 18% international students (for example from Jordan, China and Chile) and 14% of unknown ethnicity.

![Figure 6: The ethnicity of the students in the program.](image)

**Recruiting/Admission Procedures**

The program relies on two approaches for recruiting new students: the ES web page (www.unr.edu/idgrad/esh/), and the efforts of individual faculty. The number of applicants has declined in recent years. The program must work with the University of Nevada Graduate School recruiting staff to target undergraduate programs at other universities in the region to ensure a competitive pool of applicants. Figure 7 shows trends in new students admission for past decade.

![Figure 7: New students admitted.](image)
Teaching Assistantship (TA) and Research Assistantship (RA) Trends
ES students are primarily supported as research assistants (R.A.). A limited number of teaching assistantships (T.A.) is supported by the University of Nevada Graduate School and participating departments. The budget for the ES program, including student support, is shown in Appendix C. Increasing support of ES students will be necessary to sustain students already in the program and recruit high quality students.

Seminars/Student Government
The ES program has two seminar series per year, listed as NRES 790. Appendix D shows the 2006-2007 seminar schedules, with speakers and topics. In 2007, the ES program established a student speaker committee to identify and invite speakers of interest to students in the program. Part of the responsibility of students who are formally enrolled in the seminar for academic credit is to identify speakers that they will introduce. The ES program supports student selections of speakers by providing travel funds when needed, and by organizing meetings and social functions with speakers.

In addition the ES program encourages dialog across disciplinary boundaries by co-sponsoring seminars with the Hydrologic Sciences Graduate Program and the Environmental Engineering Graduate Program. We co-sponsor speakers for two reasons. First, the ES program has modest resources to support visits from speakers who must travel. Also, current enrollment in the seminar class is generally fewer than 10 students. Attendance by faculty is relatively small (5-6 ES faculty members per seminar). Therefore combining resources with other programs leads to increases in available resources for attracting notable speakers and ensures that seminars will be well-attended by students and faculty. The latter is particularly important because we feel that speakers who agree to travel to the University of Nevada should have a large and interested audience for their presentations.

Students currently are not involved in program governance and curriculum although participation is specified in the program bylaws (Appendix L). The issue of governance and student involvement is linked closely to program cohesiveness. Currently, the strength of the program, multidisciplinary participation, also contributes to difficulties in developing and maintaining a clear program identity. Student involvement is an important element of the program that should be reinstituted, particularly by drawing on the experience of students who have at least one year’s experience in the program. Their impressions, and especially their suggestions for improvements, could strengthen the program significantly.
**Advising/Conflict Resolution**
Advising is a joint responsibility of the faculty advisor and student graduate committee with the bulk of the responsibility handled by the faculty advisor. The program allows the student and advisor to create the best mix of classes and experiences. Because of this approach, students rarely have the same program of study or internship experiences.

The ES program director and the student’s graduate committee resolves rare conflicts when they arise. Every effort is made to have good communication throughout to avoid potential conflicts.

**Student Research Output**
A partial list of student research publications and theses and dissertation titles can be found in Appendices E and I.

**Employment of ES Graduates**
Employment data for ES graduates have not been maintained. This is a goal for coming years because such data are important for program evaluation and student recruitment. An informal poll of ES faculty shows MS and Ph.D students obtaining employment in the following sectors, shown in Figure 8, below:

![Figure 8. Student employment following graduation](image)

<table>
<thead>
<tr>
<th>Employment Type</th>
<th>MS</th>
<th>PhD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private Sector</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Federal Government</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Not for Profit</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Education/Research</td>
<td>3</td>
<td>-</td>
</tr>
</tbody>
</table>

*Figure 8. Student employment following graduation*
## Part III

### Faculty

#### Faculty Composition and Workloads

**Description and distribution of faculty**

The faculty of ES currently consists of 26 faculty members from 6 UNR departments, DRI and two other entities (USGS and a private firm (see footnotes below)).

<table>
<thead>
<tr>
<th>Name (Last, First)</th>
<th>Affiliation</th>
<th>Rank</th>
<th>Tenure Status</th>
<th>Degrees Held</th>
<th>Gender</th>
<th>Ethnicity*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adams, Dean</td>
<td>Engineering</td>
<td>Professor</td>
<td>Tenured</td>
<td>Ph.D. Utah State University</td>
<td>M</td>
<td>C</td>
</tr>
<tr>
<td>Chandra, Sudeep</td>
<td>CABNR² /NRES³</td>
<td>Asst. Professor</td>
<td>Non-tenured</td>
<td>Ph.D., U.C. Davis</td>
<td>M</td>
<td>A</td>
</tr>
<tr>
<td>Chow, Judith</td>
<td>DRI⁴ /DAS⁵</td>
<td>Professor</td>
<td>Research</td>
<td>MS; Sc.D., Harvard Univ.</td>
<td>F</td>
<td>A</td>
</tr>
<tr>
<td>Gault, Ruth</td>
<td>UNSOM⁷ Micro&amp;Immunol</td>
<td>Adjunct</td>
<td>Non-tenured</td>
<td>Ph.D.</td>
<td>F</td>
<td>C</td>
</tr>
<tr>
<td>Gertler, Alan</td>
<td>DRI/DAS</td>
<td>Research professor</td>
<td>Non-tenured</td>
<td>Ph.D., UCLA</td>
<td>M</td>
<td>C</td>
</tr>
<tr>
<td>Gustin, Mae</td>
<td>CABNR/NRES</td>
<td>Associate Professor</td>
<td>Tenured</td>
<td>MS U of NC-Chapel Hill; Ph.D. U of A</td>
<td>F</td>
<td>C</td>
</tr>
<tr>
<td>Hoekman, S. Kent</td>
<td>DRI/DAS</td>
<td>Research professor</td>
<td>Non-tenured</td>
<td>Ph.D.; Calvin College, Grand Rapids, MI</td>
<td>M</td>
<td>C</td>
</tr>
<tr>
<td>Je, Chung-hwan</td>
<td>EH&amp;S⁸</td>
<td>Admin. Faculty</td>
<td>Non-tenured</td>
<td>MS, Univ. Colorado, Boulder; Ph.D. Univ. Utah</td>
<td>M</td>
<td>A</td>
</tr>
<tr>
<td>Loomis, Dana</td>
<td>School of Public Health, University of Nevada, Reno</td>
<td>Professor</td>
<td>Tenured</td>
<td>M.S. U of NC-Chapel Hill; Ph.D.; MSPH</td>
<td>M</td>
<td>C</td>
</tr>
</tbody>
</table>

* C = Caucasian. A = Asian
² College of Agriculture, Biotechnology and Natural Resources, University of Nevada
³ Department of Natural Resources and Environmental Sciences, CABNR, University of Nevada
⁴ Desert Research Institute, Reno, Nevada
⁵ Division of Atmospheric Sciences, DRI, Reno, Nevada
⁶ Division of Earth and Atmospheric Sciences, DRI, Reno, Nevada
⁷ University of Nevada, School of Medicine, Department of Microbiology and Immunology
⁸ Environmental Health and Safety Department, University of Nevada, Reno, Nevada
<table>
<thead>
<tr>
<th>Name (Last, First)</th>
<th>Affiliation</th>
<th>Rank</th>
<th>Tenure Status</th>
<th>Degrees Held</th>
<th>Gender</th>
<th>Ethnicity*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miller, Glenn</td>
<td>CABNR/NRES</td>
<td>Professor</td>
<td>Tenured</td>
<td>Ph.D., U.C. Davis</td>
<td>M</td>
<td>C</td>
</tr>
<tr>
<td>Murphy, William</td>
<td>UNSOM / Microbiology</td>
<td>Professor</td>
<td>Tenured</td>
<td>Ph.D., Univ.Texas</td>
<td>M</td>
<td>C</td>
</tr>
<tr>
<td>Murray, Alison</td>
<td>DRI / DEES</td>
<td>Associate Professor</td>
<td>Non-tenured</td>
<td>MS, San Francisco State Univ; Ph.D., U.C. Santa Barbara</td>
<td>F</td>
<td>C</td>
</tr>
<tr>
<td>Nowak, Bob</td>
<td>CBANR / NRES</td>
<td>Professor</td>
<td>Tenured</td>
<td>MS, Utah State Univ; Ph.D., Univ. Minnesota</td>
<td>M</td>
<td>C</td>
</tr>
<tr>
<td>Omaye, Stan</td>
<td>CBANR / Nutrition</td>
<td>Professor</td>
<td>Tenured</td>
<td>MS, U of the Pacific; Ph.D., UCD</td>
<td>M</td>
<td>A</td>
</tr>
<tr>
<td>Pritsos, Chris</td>
<td>CBANR / Nutrition</td>
<td>Professor</td>
<td>Tenured</td>
<td>Ph.D., UNR</td>
<td>M</td>
<td>C</td>
</tr>
<tr>
<td>Qualls, Jerry</td>
<td>CABNR / NRES</td>
<td>Associate Professor</td>
<td>Tenured</td>
<td>MS Public Health, Univ. North Carolina; Ph.D., Univ. Georgia</td>
<td>M</td>
<td>C</td>
</tr>
<tr>
<td>Sagabiels, John</td>
<td>EH &amp; S</td>
<td>Admin Faculty</td>
<td>Non-tenured</td>
<td>Ph.D., UC Davis</td>
<td>M</td>
<td>C</td>
</tr>
<tr>
<td>Seiler, Ralph</td>
<td>USGS 9</td>
<td>Adjunct Faculty</td>
<td>Non-tenured</td>
<td>MS, Univ. Utah; Ph.D., UNR</td>
<td>M</td>
<td>C</td>
</tr>
<tr>
<td>Tsukamoto, Timothy</td>
<td>Ionic Water Technologies</td>
<td>Adjunct Faculty</td>
<td>Non-tenured</td>
<td>Ph.D. UNR</td>
<td>M</td>
<td>A</td>
</tr>
<tr>
<td>Verburg, Paul</td>
<td>DRI / DEES</td>
<td>Associate Research Professor</td>
<td>Non-tenured</td>
<td>MS; Ph.D., Wageningen Agricultural Univ., The Netherlands</td>
<td>M</td>
<td>C</td>
</tr>
<tr>
<td>Walker, Mark</td>
<td>CABNR / NRES</td>
<td>Associate Professor / Program Director</td>
<td>Tenured</td>
<td>MS, U of A; Ph.D., Cornell Univ.</td>
<td>M</td>
<td>C</td>
</tr>
<tr>
<td>Yang, Wei</td>
<td>EH &amp; S</td>
<td>Professor</td>
<td>Non-tenured</td>
<td>M.D., Nanjing Medical College, Nanjing, China; MS; Ph.D., UNR</td>
<td>M</td>
<td>A</td>
</tr>
<tr>
<td>Zielinska, Barbara</td>
<td>DRI / DAS</td>
<td>Research Professor</td>
<td>Research</td>
<td>MS, Tech Univ. of Lodz, Poland; Ph.D., Polish Academy of Sciences</td>
<td>F</td>
<td>C</td>
</tr>
</tbody>
</table>

* C = Caucasian. A = Asian
9 U.S. Geological Survey, Water Resources Division, Carson City, NV
The program bylaws (Appendix L) specify the minimum qualifications and procedures for admitting faculty members into the Environmental Sciences program. Faculty request or are nominated for membership and are admitted after presenting a seminar, their credentials and a statement of interest. Admission is contingent upon a majority positive vote by core faculty. Areas of faculty expertise are described in Appendix F, which summarizes faculty research interests. Contact information for the faculty can be found in Appendix G.

The ES maintains faculty based on their level of involvement in the program. The ES does not have specific requirements for graduate faculty status, but rather defaults to those of the Graduate School. The University of Nevada Graduate School policy states that faculty employed by UNR and DRI may serve in all capacities of graduate education in ES; those faculty from USGS or other such organizations have only the restriction of co-chairing student committees. In these cases, a UNR or DRI graduate faculty member must serve as co-chair of either an MS or doctoral student committee. A terminal degree (Ph.D.) is required to serve on the Graduate Faculty.

Dr. Chris Pritsos, Chair of the Nutrition Department in the College of Agriculture, Biotechnology and Natural Resources, studies the effects of environmental tobacco smoke on workers, protection by antioxidants, and the mechanism of action of several anticancer agents.
**Faculty Allocation of Responsibilities**

The program relies on courses offered through departments. Currently the core courses for each track are taught by ES faculty in the Departments of Natural Resources and Environmental Sciences, Nutrition, Civil and Environmental Engineering, and Biology, and the School of Public Health. As noted earlier, ES faculty have primary affiliations with departments or research units. The departments and research units oversee and evaluate apportionment of faculty time.

The ES program hires short-term instructional faculty on a letter of appointment basis to teach courses. Although the use of these has been sparing in the history of the program, we plan to develop courses that may become part of the core on an exploratory basis with the help of such faculty.

The current arrangement leads to fragmentation and incomplete control over course content, including development and continuance of courses that meet student needs. The University offers a limited number of 700 level courses that are suitable for meeting the requirement for completion of graduate studies. In addition, there is no formal mechanism to ensure that new course offerings meet the needs of students in the program. One potential remedy for this is to establish and maintain good communication with chairs of departments that have faculty participating in the ES program. The ES program is dependent upon departmental and college concurrence about needs and objectives and how to best meet them. Given that the ES has no faculty dedicated solely to the program (with the exception of the director) it is important to ensure that participating departments place a high priority on helping to meet program objectives.

**New Faculty Searches**

Because the ES graduate program is dependent on faculty from various departments and divisions on campus and at DRI, the program has limited input in faculty search criteria, including qualifications and expectations for course offerings.
Research, Scholarship, Creative Activity, Outreach, and Professional Service

Resumés of ES faculty members are included in Appendix H. In addition, research interests of faculty member are indicated in Appendix F. Overall, ES faculty members have done an excellent job maintaining their research programs, given growing undergraduate teaching loads and service commitments imposed by the institution over the past seven years.

Research and Scholarship
An accounting of faculty research publications, awards, outreach and professional service can be found on their individual resumés found in Appendix H.

Comparison to Similar Programs
The ES graduate program is one of 5 in the western United States (Table 1). Each has unique characteristics, with respect to the administrative home within their respective institutions and the types of course work required. Four of five of the programs involve more than one department and offer multidisciplinary flexibility with respect to course work. For the most part, this means that student course work is specified by a graduate committee.

Each of the programs in Table 1 is growing, in some cases very quickly. As an example, the University of North Dakota’s Earth System Science and Policy program began with five students in 2005 and now has 38 students. The director of North Dakota’s graduate program attributed the growth to increased publicity about global climate and other aspects of environmental sciences. In addition, the director pointed out that jobs appear to be plentiful for recent graduates of such programs. In fact, a recent search of http://www.ecoemploy.com/jobs/ (a web site specializing in posting jobs related to environmental sciences) indicated that there were approximately 30 openings posted for positions in the western United States in the last 30 days.
### Table 1

**Characteristics of Master's and Doctoral Programs in Environmental Sciences in the western United States**

<table>
<thead>
<tr>
<th>Institution</th>
<th>Master's and Doctoral Program</th>
<th>Administrative Home</th>
<th>Current M.S./Ph.D enrollment (trends)</th>
<th>Required Course Work</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>U.C. Santa Barbara</strong></td>
<td>M.S. and Ph.D. in Environmental Science and Management</td>
<td>Donald Bren School of Environmental Science and Management</td>
<td>30 Ph.D. 130 M.S. (growing)</td>
<td>Committee specified; three types of seminars required</td>
</tr>
<tr>
<td>Environmental Science and Management</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Montana State University – Bozeman</strong></td>
<td>M.S.- Land Resources and Environmental Sciences. Ph.D. Ecology and Environmental Science</td>
<td>Land Resources and Environmental Sciences Department</td>
<td>20 Ph.D. 20 M.S. (steady enrollment/newly established Ph.D. program)</td>
<td>Committee specified; no core courses required</td>
</tr>
<tr>
<td>Land Resources and Environmental Sciences</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><a href="http://landresources.montana.edu/lres_graduate.html">http://landresources.montana.edu/lres_graduate.html</a></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Washington State University</strong></td>
<td>M.S.- Environmental Science Ph.D.- Environmental and Natural Resource Sciences</td>
<td>Interdisciplinary -- sponsored by the Natural Resource Sciences Department and the Program in Environmental Science and Regional Planning</td>
<td>12 Ph.D. 8 M.S. (growing)</td>
<td>Requires courses that develop competency in five broad areas (see <a href="http://www.wsu.edu:8000/~franz/dcurr.html">http://www.wsu.edu:8000/~franz/dcurr.html</a>)</td>
</tr>
<tr>
<td>Environmental and Natural Resource Sciences</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>University of North Dakota</strong></td>
<td>Master of Environmental Management M.S and Ph.D.-Earth System Science and Policy</td>
<td>Integrated program, established in Fall 2005</td>
<td>2 Ph.D. 36 M.S. (growing)</td>
<td>Committee specified</td>
</tr>
<tr>
<td>Earth System Science and Policy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Part IV
Program Resources, Physical Plant, and Facilities

Funding Sources
The ES program relies upon faculty and departments for resources such as analytical capabilities and computing resources. Individual investigators obtain grants for student support and project costs, generally through their departments and home institutions. In addition, the Graduate School provides funding for program costs. For example, in 2006/2007 (see Appendix C for details of the budget allocation) the Graduate School budgeted $45,257 for program activities including TA’s, travel, director’s stipend and office operations.

From 2000-2007, cumulative awards to faculty members in the program total $85 million, in 566 grants and contracts. The average per faculty member is $3.4 million during the seven year period, with a standard deviation of $5.8 million. The large standard deviation indicates that a small proportion of the faculty brings in a large proportion of grant funds. It is also difficult to accurately account for grants and contracts that have been awarded because of affiliation with the program.

Physical Facilities
The program had the following physical facilities in 2006/2007. The director is housed in an office provided by the College of Agriculture, Biotechnology and Natural Resources, through the Department of Natural Resources and Environmental Sciences in the Fleischmann Agricultural Building. Faculty affiliated with the program are housed in the Fleischmann Agricultural Building, the Sarah Fleischmann Building, the Knudtsen Resource Center, the Applied Research Facility, the Lombardi Recreation Center, the School of Medicine, and the Desert Research Institute. Office and laboratory space is primarily the responsibility of the faculty members home department rather than their association with the ES program.

Equipment is provided with funds from grants and contracts to individual faculty, the University of Nevada Graduate School and various faculty start-up funds over the past decade. Equipment has not been a significant limiting factor for ES students or faculty. Most participating faculty maintain their own equipment and freely allow students to use equipment, laboratory facilities and software.

Graduate students Marnie Benson (right) and DeEtta Fosbury (left) worked with Dr. Mark Walker to characterize exposure to arsenic through water from private wells in Churchill County, Nevada.
Part V
Future Plans

Strengths and Challenges

Strengths of the program:
Interdisciplinary involvement – student and faculty opportunity:
The Environmental Sciences Interdisciplinary Graduate Program offers graduate students the opportunity to work closely with faculty from a wide range of discipline-based departments and research units at the University of Nevada. The ES graduate program allows students great flexibility in developing and designing programs of study and research that represent a nexus of disciplines. Accordingly, the ES program has the potential to offer students and faculty a rich academic experience that may be difficult to achieve in discipline-based departments and research units.

Interdisciplinary involvement – outlet for doctoral studies for departments and research units:
The ES program enjoys and depends upon participation from departments and research units of the University of Nevada and the Desert Research Institute. Some of these departments, for example the Department of Natural Resources and Environmental Sciences and divisions of the Desert Research Institute, do not maintain doctoral programs or, in the case of the Desert Research Institute, master’s programs. In the case of departments at the University of Nevada, those that do not offer doctoral programs may lack students and faculty to start and sustain such programs. The ES program offers an outlet for such departments by providing flexibility in design of curriculum and research approach that can accommodate a wide range of disciplines. In the case of the Desert Research Institute, the ES program offers an academic home for master’s and doctoral students who may be supported and supervised by DRI research faculty.

Recognition as a regional leader in environmental sciences:
Graduate students and researchers from the ES program have made important contributions to regional research and continue to attract regional and national attention because of the quality of their work. This includes issues such as:
- Effects of marine, two-cycle engine use on water quality at Lake Tahoe,
- Gaseous mercury emissions from background sources and mining activities, and
- Effects of environmental tobacco smoke on human health, especially in public spaces (such as casinos) where tobacco use is common.
Support from the Graduate School: The Graduate School of the University of Nevada has provided general support for the ES program at a steady funding level of approximately $45,000 per year, which is based on program enrollment. While the support has not been sufficient for administrative support within the program (for example, for a part-time program assistant), program needs have been modest for the past several years. The support provided by the University has been sufficient to prevent interruptions in graduate student funding, to support the ES seminar series and to help faculty and students travel to meetings and present results of research.

Challenges of the program:

**Interdisciplinary involvement – program identity:**

Because of the diversity of student interests and faculty expertise and the flexibility provided to design programs of study and research, it is sometimes difficult to clearly articulate the foci of the tracks and the program. For example, students and faculty involved in other interdisciplinary programs at the University of Nevada (e.g. the Hydrologic Sciences program) nominally have an identity and focus that is well-communicated in the program's name. This is a strong advantage in terms of recognizability of the type of training that has been a part of student preparation. The Environmental Sciences program, because of its internal diversity (two tracks) and flexibility, cannot be identified with the same succinctness. This challenge is manifested in more than one way. First, the program does not have societal affiliations, including student chapters of societies. Individual faculty members and students are participants in a wide range of societies; however, there are currently none with chapters on the campus that students are encouraged to join. Second, anecdotally, potential employers have difficulty understanding what skills graduates of the program are likely to have. The skill set for either track is largely defined by courses of study and research focus for individual students. Each student has skill sets that may differ dramatically from those of other students in the program. As a consequence, several potential employers have communicated uncertainty about what can be expected of graduates of the ES program.

**Faculty involvement – departmental and research unit administrative expectations:**

The challenges of participation in the program by faculty from departments and research units are related to administrative expectations for performance within such departments and research units. Faculty participation in the program is voluntary. Although such participation may be seen as an important contribution by a department or research unit that conducts annual performance reviews of participating faculty, it may also be disregarded in the overall context of priorities and performance criteria that are external to the ES program.
Faculty involvement – program ownership:
One of the challenges associated with participation of faculty from diverse departments is establishing a sense of ownership of the program. Attendance at faculty meetings for the program is complicated by similar demands associated with departments and research units. In addition, the lack of a physical center for the program and the distribution of faculty across campuses are barriers to participating in meetings. As a consequence, it is difficult to establish and maintain committees to serve as working groups.

Student involvement:
Student involvement in program administration and management is currently minimal. During the 2007 Spring Semester, a student committee helped to organize the NRES 790 Environmental Sciences Seminar. However, students in the program have no central meeting place nor common class experiences beyond the seminar series and required core courses. As a consequence, students have limited contact with other students in the program.

Enrollment trends and recruitment:
Enrollment in the program is directly related to recruitment efforts. The program received applications from eight prospective students (3 Ph.D. and 5 M.S.) in the past year, two of whom were accepted for admission in Fall 2007. This modest pool of applicants did not fully replace graduating students (three completed degree requirements in the 2007 calendar year). Although this does not represent a significant decline in the program, it will be important in the future to maintain and increase student numbers, which are at about half of that desired. This will be dependent in part upon resources available to support students, including teaching and research assistantships. The latter is the responsibility of participating faculty and fully dependent upon success with grants and contracts. The former is dependent upon departmental allocations, which place departmental needs as first priority and may or may not consider the ES program needs with regards to student support. This requires engagement and advocacy at the departmental level by faculty who are participating in the ES program.

The recently established School of Public Health at the University of Nevada offers MS programs in Public Health, with the following specializations:
- epidemiology
- social/behavioral health
- health ethics, policy, and administration
- public health leadership
- child, family, and lifespan health, and
- bioethics certificate aging and nutrition.

Kendra Zamzow, a recent graduate of the Environmental Sciences Doctoral program, conducted environmental studies on St. Lawrence Island, in Alaska. Her research focused on acid mine drainage and strategies for remediation. Dr. Zamzow was active in selecting speakers for the Environmental Sciences Graduate Program Seminar Series.
The School of Public Health is developing a proposal to grant doctoral degrees and to add a track in Environmental Health. Although this suggests potential overlap, the proposals are in the earliest stages of development. This will require careful coordination between the ES program and School of Public Health, possibly leading to redefinition of the Environmental Health track within the ES program. The ES and School of Public Health programs have begun informal discussions of the relationship between the programs, with an emphasis on coordinating and mutually supporting graduate research in Environmental Health. In addition, it is possible that the ES program will serve as an outlet for Ph.D. level research in the short term for the School of Public Health, though it is unclear how this will evolve as the School’s proposal for a Ph.D. program is developed.

**Lack of a physical center for the students and faculty:**
Students and faculty in the ES program are housed in many locations on the University of Nevada and Desert Research Institute’s campuses. As previously pointed out, the program is currently without a physical center that could accommodate occasional meetings and administrative and organizational functions. A fixed administrative location with a faculty and student meeting room would provide a physical center for the program that could be used for faculty meetings, seminars and student functions such as research presentations and defenses.

**Projections**
The program recently added four faculty, from the University of Nevada School of Public Health (two) and the Desert Research Institute Division of Atmospheric Sciences (two). Although more faculty participation is useful, it is important that the ES program carefully consider program needs to guide recruitment of faculty and students. Given recent decreases in student enrollment, it is important that the program work with existing faculty to attract students from institutions with environmental science B.S. and M.S. programs. Also, it will be important to work with departments at the University of Nevada and the Desert Research Institute to hire new faculty that fill critical needs for the program.

**Program Changes**
The following changes are meant to address two critical issues: increasing student enrollment and clarifying program identity. These include establishing a program advisory committee, a program steering committee, focusing recruitment efforts for students, defining a thematic focus, tracking student employment, evaluating faculty participation, tracking grant and contract success, establishing new courses to promote student success and program cohesiveness and increasing competition for training grants to support graduate students and enhance program visibility. Each is discussed on the following pages.
Advisory committee:
The program could benefit from a committee composed of members external to the program, with appointed members representing state and federal government, the private sector, not for profit groups, selected faculty from the University of Nevada and ES alumni. Such a committee is required by the bylaws of the program (Appendix L), but has not been active in recent years. Ideally, members would have had contact with graduates of the ES program and could offer insights as potential employers about expectations of graduates. The committee could serve several valuable functions, including:

- Periodic review of the core curriculum for the Environmental Processes and Environmental Health tracks,
- Increasing awareness of the ES program among potential employers, and
- Identifying opportunities for collaboration and student research.

Internal steering committee:
A program steering committee will advise the Program Director about general operation. The steering committee should be comprised of track leaders, at least one student representative and the Program Director. The Program Director would chair the committee and convene meetings.

Focused recruitment:
The ES program has declining enrollment and nearly no recruitment efforts apart from the program web site and the individual efforts of faculty. It would be useful to focus recruiting efforts, especially announcements that seek teaching and research assistants, on regional schools that offer environmental science Bachelor’s programs. These include universities in the University of California system, University of Arizona, and several in Washington, Oregon and Utah. A first, important step will be redesign of the program web site to highlight the research of faculty and students, with careful attention to acquiring and maintaining current biographies. In addition, the web site should have clear, informative photographs and other graphic information that offers attractive descriptions of ongoing research.

Tracking student employment:
Results of a recent e-mail poll about post-graduate employment (shown in Figure 8) brought few responses. ES has very little information about post-graduate success in employment. Such information is critical for several reasons. First, current employers can offer useful assessments about their expectations of students with M.S. and Ph.D. degrees in either track in Environmental Science. Second, former students can offer assessments of the utility of course work and research as preparation for entry into the job market. Third, former students may be able to offer job opportunities to students in the ES program who are about to graduate.
Evaluating faculty participation:
The program bylaws (Appendix L) indicate that appointment to the program be on a three year basis. Faculty participation is important to maintain all aspects of the program, but especially with regards to actively supporting student research (as a chair, sponsor or committee member), attending program functions (especially the program seminar), developing courses needed by the program and teaching courses important for the program. These four criteria should be used in the future to periodically revise the roster of faculty participants to ensure that the web site list of faculty includes only those considered to be active in the program. One of the primary tasks associated with this is developing evaluation criteria and determining how often the current list of participants should be evaluated.

Tracking grant and contract success:
Grant and contract success associated with the ES program is difficult to evaluate, especially because ES as an entity does not receive grants and contracts directly. Although the program can report on the grant and contract success of individual faculty members, this may be inaccurately reflecting success that can be attributed to the existence of the ES program. In the future, the program should have a way of tracking the value added to departmental, college and research unit research and contract funding. This feature (funding acquired because of the existence of the ES program) should be reported to demonstrate the value of the program to the University and participating administrative units.

Thematic focus:
The ES program offers two tracks that have broad titles, have some parts of required curriculum in common, and between which there is inadequate communication and cohesiveness. This is apparent in attendance at seminars, which often attract faculty interested in specific topics related to a track but rarely attract faculty who are participants in both tracks. The core curriculum requirements are frequently revisited and sometimes revised. However, in spite of the overlap in requirements between the two tracks, it may be appropriate to select a single focus for the program that provides a common core for interdisciplinary research, and a clear program identity while maintaining the flexibility that is an important and valued characteristic of the ES program. Ideally, this single theme would have an identity that could be associated with a specific professional society. One of the advantages of such an association would be the opportunity to form a student chapter that would help promote cohesiveness among students (see below). A single theme could also suggest a core curriculum that provides appropriate theoretical and applied training.

An appropriate theme may be related to risk assessment, including hazard identification, dose-response assessment, exposure assessment, and risk characterization. This theme suggests affiliations with federal and state agencies that support basic and applied research related to risk assessment. In addition, several international societies focus on the field in general (e.g. the Society for Risk Analysis and Society of Environmental Toxicology and Chemistry (SETAC)) and support student chapters.
Promote program cohesiveness:

Several initiatives may enhance cohesiveness:
- Adherence to the program bylaws;
- A societal affiliation that would have a local student chapter; and
- An internal seminar series for faculty and graduate students who have been in the program for at least one year (1 credit).

The program bylaws (Appendix L) must be revised, but remain relevant. As noted throughout the document, the bylaws specify levels of student participation and criteria for faculty involvement, including evaluation of faculty participation. The bylaws should be revised immediately, though most of the original operational criteria and procedures should be retained. A societal affiliation for students would provide a unifying theme and body that would promote student interaction across disciplines. The internal seminar series would provide students with the opportunity to present results of ongoing research to other students involved in the ES program. Faculty in the ES program would also present overviews of their research.

Compete for training grants:

A variety of training grants to support graduate students is available through competitive programs, for example those offered by the National Science Foundation. These include the Integrative Graduate Education and Research Traineeship Program (IGERT), which supports doctoral fellows, and other programs to support graduate education in science, technology, engineering and mathematics. In addition, it would be useful to recruit students from existing research experiences for undergraduates programs with appropriate emphases.
Course Descriptions: Required and Elective Courses

REQUIRED COURSES: Environmental Sciences Interdisciplinary Graduate Program
Students in both tracks (Environmental Processes and Environmental Health) must take the Environmental Sciences seminar (NRES 790; MS – 3 hrs, Ph.D – 4 hrs). The Environmental Processes Track requires four of the following courses indicated with EP. The Environmental Health Track requires BCH 400/600 and three of the following courses indicated with EH:

(EP)BCH 400/600 INTRODUCTORY BIOCHEMISTRY
Lecture+Lab: 4+0  Credit(s): 4
A comprehensive overview of the three major areas in Biochemistry. Structure Function of Biomolecules, Metabolism, and Molecular Biology.

(EP, EH)NRES 430/630 ANALYSIS OF ENVIRONMENTAL CONTAMINANTS
Lecture+Lab: 3+0  Credit(s): 3
Trace analysis of chemicals in the environmental. Extraction, separation, detection, and determination of chemicals using chromatographic and spectrometric methods.

(EP, EH)NRES 432/632 ADVANCED ENVIRONMENTAL TOXICOLOGY
Lecture+Lab: 3+0  Credit(s): 3
Chemistry and toxicology of toxicants in the environment, particularly pesticides. Other topics include metals, food additives and hazardous wastes.

(EP, EH)NRES 433/633 ENVIRONMENTAL CHEMICALS: EXPOSURE, TRANSPORT AND FATE
Lecture+Lab: 3+0  Credit(s): 3
Physical, chemical, and biological properties governing exposures to chemicals in the environment, modeling of transport and fate processes, and contaminant remediation.

(EH)NUTR 728 FOOD AND NUTRITIONAL TOXICOLOGY
Lecture+Lab: 2+0  Credit(s): 2
Physiologic and metabolic principles of action of toxicants found in foods. Selective toxicity and detoxification mechanisms and food safety assessment techniques will be stressed.

(EH)PUBH 673 FUNDAMENTALS OF EPIDEMIOLOGY
Lecture+Lab: 3+0  Credit(s): 3
Nature of disease patterns and occurrences. Etiology, recognition, transmission, prevention, and principles used in the control of disorders affecting human health. (Formerly HE 673; implemented Spring 2005.)

(EH)PUBH 780 BIOSTATISTICS IN PUBLIC HEALTH
Lecture+Lab: 3+0  Credit(s): 3
Introduction to the underlying principles of biostatistics and a variety of statistical applications in public health research.

(EPE)CEE 756 ENVIRONMENTAL CHEMISTRY
Lecture+Lab: 3+0  Credit(s): 3
Kinetics and thermodynamics applied to water, wastewater, and other environmental media including acid-base relationships, complexation, precipitation, and oxidation reduction.

(EP)Biol 420/620 AQUATIC ECOLOGY
Lecture+Lab: 2+3  Credit(s): 3
Biological, chemical, and physical characteristics of aquatic environments with particular emphasis on ecological processes.
Appendix A

(EP) NRES 765 BIOGEOCHEMICAL CYCLES
Lecture+Lab: 3+0  Credit(s): 3
Cycling of constituents between the hydrosphere, lithosphere, atmosphere and biosphere, and anthropogenic perturbations of these cycles.

(EP) ATMS 412/612 INTRODUCTION TO AIR POLLUTION
Lecture+Lab: 3+0  Credit(s): 3
Aerosol and gas phase classification and measurement; regulatory requirements and control technology; smog, acid deposition and the ozone layer. Local and long-range transport.

(EP) ATMS 747 ATMOSPHERIC CHEMISTRY
Lecture+Lab: 3+0 Credit(s): 3
Applications of organic and inorganic chemistry to atmospheric sciences, including atmospheric evolution, air pollution, climate change, biogeochemistry and environmental regulation.

(EPEH) NRES 790 SEMINAR
Lecture+Lab: 1+0  Credit(s): 1  S/U only
Presentations of potential research projects and research results by graduate students and faculty. Maximum of 6 credits.

(EPEH) NRES 797 THESIS
Credit(s): 1 to 6
Thesis may be written in area of natural resources management, hydrology/hydrogeology, conservation biology, or environmental chemistry.

ELECTIVE COURSES
Students in the program have taken the following courses as electives. There are no restrictions on elective courses, though the planned course work must be approved as part of the student’s program of study.

ATMS 414/614 PHYSICAL CLIMATOLOGY
Lecture+Lab: 3+0  Credit(s): 3
Physical basis for behavior of the climate system; flows and reservoirs of mass and energy; temporal and spatial scales of variability; contemporary climate issues.

ATMS 706 APPLIED DATA ANALYSIS
Lecture+Lab: 3+0  Credit(s): 3
Philosophy of data analysis, statistical critical thinking, exploratory data analysis, regression, multivariate methods, spatial and time series analysis, randomization, bootstrap, Monte Carlo methods, statistical graphics.

APST 412/612 APPLIED GEOGRAPHIC INFORMATION SYSTEMS
Lecture+Lab: 2+3  Credit(s): 3
Use of PC Arc/Info to work through projects relating to community and economic development, environmental and natural resource sciences.

APST 463/663 DESIGN AND ANALYSIS OF EXPERIMENTS
Lecture+Lab: 3+0  Credit(s): 3
Statistical methods related to single factor, factorial, repeated measures and split-plot designs in engineering, physical, life, and environmental sciences and statistical programming.

APST 470/670 LINEAR REGRESSION AND TIME SERIES
Lecture+Lab: 3+0  Credit(s): 3
Application of multiple regression and time series regression models in economics, life and environmental sciences. Computers will be utilized.
APST 705 LINEAR AND NONLINEAR REGRESSION MODELS  
Lecture+Lab: 3+0  Credit(s): 3  
Applications of simple, multiple, linear and nonlinear regression models, and time series analysis in the fields of biology; engineering; physical, life and environmental sciences; and economics. Emphasis is given to computer applications.

APST 755 MULTIVARIATE STATISTICAL METHODS  
Lecture+Lab: 3+0  Credit(s): 3  
Application of MANOVA and regression, principle component and factor analysis, discriminant, canonical correlations, and cluster analyses in sociology, life, and environmental sciences. Emphasis on SAS.

ATMS 792 SPECIAL PROBLEMS  
Credit(s): 1 to 6  
Special study of advanced topics not specifically in courses or seminars. Maximum of 6 credits in special problems courses.

BCH 410/610 PLANT PHYSIOLOGY  
Lecture+Lab: 3+0  Credit(s): 3  
Basic physiological processes in plants, nutrition, metabolism, growth and development.

BCH 413/613 MOLECULAR BIOPHYSICS  
Lecture+Lab: 3+0  Credit(s): 3  
Molecular basis of structural biology and biological catalysis; protein, membrane and polysaccharide conformation; supramolecular assembly; enzyme kinetics; molecular recognition.

BCH 417/617 METABOLIC REGULATION  
Lecture+Lab: 3+0  Credit(s): 3  
In-depth examination of metabolism and regulation of carbohydrates, lipids, isoprenoids, amino acids, relationship of metabolism to the life processes of the whole organism.

BCH 701-702 EXPERIMENTAL BIOLOGY I AND II  
Lecture+Lab: 0+9  Credit(s): 3 each  
Intensive laboratory in biochemical research methodology. Oral and written reports on each research project required. Biochemistry majors.

BCH 705 R MOLECULAR GENETICS  
Lecture+Lab: 3+0  Credit(s): 3  
Molecular view of prokaryotic and eukaryotic genes. Structure, expression and regulation of genes. Genetic engineering.

BCH 706 FUNCTIONAL GENOMICS  
Lecture+Lab: 3+0  Credit(s): 3  
Systematic analysis of gene function on a genome scale using high-throughput experimental methodologies, bioinformatics tools, and systems biology approaches.

BIOL 705 CURRENT TOPICS IN CELL AND MOLECULAR BIOLOGY  
Lecture+Lab: 2 or 3+0  Credit(s): 2 or 3  
Review and analysis of recent literature on selected topics concerning the molecular basis of cell structure and function. Maximum of 9 credits.

BIOL 712 MATHEMATICAL MODELING IN ECOLOGY  
Lecture+Lab: 3+0  Credit(s): 3  
Introduction to various mathematical tools used in modeling ecological phenomena, discussion of models in ecological literature, development of a simulation model as a project.

CEE 411/611 ENVIRONMENTAL LAW  
Lecture+Lab: 3+0  Credit(s): 3  
Examination of current federal laws, rules and regulations concerning the environment. Emphasis on court decisions and interpretations of the law.
Appendix A

CEE 453/653 ENVIRONMENTAL MICROBIOLOGY
Lecture+Lab: 3+0  Credit(s): 3
Introduction to fundamental and applied microbiological principles in environmental engineering with emphasis on microbial growth and metabolism in biological processes.

CEE 750 GRADUATE SEMINAR
Credit(s): 1 to 3
Study and discussion of important new developments in particular fields of civil engineering.

CHE 741 ADVANCED KINETICS AND REACTOR DESIGN
Lecture+Lab: 3+0  Credit(s): 3
Complex reaction rates and networks; catalytic processes; gas-solid reactions; batch, plug flow, perfectly mixed flow reactor equations; stability and analysis; homogeneous and heterogeneous models; fluidized bed reactors.

CHE 760 ADVANCED CHEMICAL ENGINEERING THERMODYNAMICS
Lecture+Lab: 3+0  Credit(s): 3
Advanced treatment of thermodynamics with application to dynamic, equilibrium, and near equilibrium systems. Measurements, derivative properties, equations of state, activity-coefficient models, reaction equilibria.

CHE 764 ADVANCED TRANSPORT PHENOMENA I
Lecture+Lab: 3+0  Credit(s): 3
Advanced concepts in theoretical and applied fluid and heat dynamics involving steady state, transient and cyclic phenomena in chemical and metallurgical engineering.

CHE 765 ADVANCED TRANSPORT PHENOMENA II
Lecture+Lab: 3+0  Credit(s): 3
Multicomponent diffusion, mass transport models, advanced concepts in analysis and design of continuous and multistage separation processes, advanced topics including recent literature.

CHEM 443 R/643 R ORGANIC SPECTROSCOPY AND STRUCTURE
Lecture+Lab: 2+0  Credit(s): 2
Constitutional and stereochemical structure from spectroscopic methods (mass spectrometry, nuclear magnetic resonance, infrared, ultraviolet).

CHEM 444/644 ORGANIC STRUCTURE DETERMINATION LABORATORY
Lecture+Lab: 0+3 or 6  Credit(s): 1 or 2
Laboratory identification of unknown organic compounds using spectroscopic instruments (IR, NMR, UV, mass spectrometry); microtechniques; separation of mixtures (GLC, TLC, HPLC).

CMB 710 MOLECULAR CELL BIOLOGY
Lecture+Lab: 4+0  Credit(s): 4
Essential elements of cell structure and function. Comprehensive and experimental approach to the molecular view of the cell.

CMB 790 GRADUATE SEMINAR
Lecture+Lab: 1+0  Credit(s): 1 S/U only
Reports by students on topics of interest in cell and molecular biology. May be repeated for a maximum of 2 credits.

CMB 794 COLLOQUIUM
Lecture+Lab: 1+0  Credit(s): 1
Presentation and analysis of original research in (a) gene regulation, (b) virology, (c) molecular biology methodology, (d) neoplasia, (e) hormone and drug receptors, (f) immunology. Maximum of 6 credits.

GEOG 405 R/605 R GIS I: GEOGRAPHIC INFORMATION SYSTEMS AND SCIENCE
Lecture+Lab: 3+3  Credit(s): 4
Introduction to modern spatial data processing, development and functions of geographic information systems (GIS); and theory, concepts and applications of geographic information science (GISc).
GEOG 407 R/607 R ADVANCED GIS ANALYSIS
Lecture+Lab: 3+3  Credit(s): 4
Advanced tools, data management, and functions in geographic information systems (GIS) (ArcGIS); topics in spatial data analysis, 3d-visualization, and modeling of geographic information science (GISci).

GEOG 409 R/609 R GIS DESIGN STUDIO
Lecture+Lab: 2+3  Credit(s): 3
Culmination course in which students are expected to apply knowledge and skills, acquired through personal experience and course work, to real world research and practical problems. Programming and command line skills will be introduced.

GEOL 701 ADVANCED GEOLOGY
Credit(s): 1 to 5 each
(a) General geology, (b) regional geology, (c) mineralogy, (d) petrology, (e) petrography, (f) geochemistry, (g) structural geology, (h) geophysics, (j) geomorphology, (k) paleontology, (m) sedimentation, (n) stratigraphy, (p) mineral deposits, (r) economic geology, (s) ground water, (t) engineering geology, (u) photogrammetry, (v) seismology, (w) instrumental analysis, (y) mineral exploration, (z) earth science. Consists of either lectures, periodic conferences, supervised reading, laboratory or field work. May be repeated more than once to pursue different studies.

GEOL 702 ADVANCED GEOLOGY
Credit(s): 1 to 5 each
(a) General geology, (b) regional geology, (c) mineralogy, (d) petrology, (e) petrography, (f) geochemistry, (g) structural geology, (h) geophysics, (j) geomorphology, (k) paleontology, (m) sedimentation, (n) stratigraphy, (p) mineral deposits, (r) economic geology, (s) ground water, (t) engineering geology, (u) photogrammetry, (v) seismology, (w) instrumental analysis, (x) teaching of earth sciences, (y) mineral exploration, (z) earth science. Consists of either lectures, periodic conferences, supervised reading, laboratory or field work. May be repeated more than once to pursue different studies.

GRAD 701 PREPARING FUTURE FACULTY: COLLEGE TEACHING I
Lecture+Lab: 2+2  Credit(s): 3 S/U only
Preparation and practicum for teaching across disciplines at the college level.

MATH 767 ADVANCED MATHEMATICS FOR EARTH SCIENCES
Lecture+Lab: 3+0  Credit(s): 3
Applications of advanced mathematics for earth scientists and engineers. Includes elements of vector calculus, linear algebra, differential equations, probability and statistics.

MICR 470/670 CELLULAR MICROBIOLOGY
Lecture+Lab: 3+0  Credit(s): 3
Molecular and cellular mechanism of microbial promotion of disease, along with host defense systems, and the indispensable and beneficial roles of microbes in human health.

MICR 476/676 CANCER IMMUNOBIOLOGY
Lecture+Lab: 3+0  Credit(s): 3
Introduction to the mechanisms of cancer development and treatment. Topics include mechanisms of carcinogenesis and neoplastic transformation, immune system and tumor surveillance and treatment options.

MICR 687 PROBLEMS IN INFECTION AND IMMUNITY
Lecture+Lab: 1+0 per credit  Credit(s): 1 to 3
Research and/or seminar-oriented elective in either bacteriology, immunology, mycology or virology.

MICR 700 BIOTECHNOLOGY TODAY AND TOMORROW
Lecture+Lab: 2+0  Credit(s): 2
Current concepts and methodologies in advanced biotechnology. Topics cover roles of microbes, plants, and animals for applied, basic, and medical applications.
Appendix A

NRES 406/606 FOREST TREE PHYSIOLOGY AND GENETICS
Lecture+Lab: 4+0  Credit(s): 4
Photosynthesis, respiration, water relations, nutrition, shoot and root development, reproduction and genetics of forest trees. Application of physiological and genetic principles in predicting effects of silvicultural practices on tree growth and in tree improvement.

NRES 701 ADVANCED RESOURCE MANAGEMENT
Credit(s): 1 to 3
Lectures, supervised reading, laboratory or field work in: (a) forest/range management, (b) wildlife/conservation biology, (c) environmental science, and (d) hydrology. Maximum of 9 credits per topic.

NRES 702 SOIL CHEMISTRY
Lecture+Lab: 2+3  Credit(s): 3
Soil chemical properties; soil solution, chemical equilibria, liquid/solid interaction, exchange, adsorption, molecular retention, transport and trace element chemistry.

NRES 746 ADVANCED ANALYSIS METHODS IN NATURAL RESOURCES
Lecture+Lab: 2+3  Credit(s): 3
Applied use and interpretation of multivariate and modeling techniques for natural resources and biological studies.

NUTR 451R/651R PRINCIPLES OF HUMAN NUTRITION AND METABOLISM
Lecture+Lab: 4+0  Credit(s): 4
Major dietary nutrients and their digestion, absorption, metabolism, regulation and role in human disease states. (Formerly NUTR 419/619; implemented Spring 2005.)

NUTR 470/670 COMMUNITY NUTRITION
Lecture+Lab: 2+3  Credit(s): 3
Programs, policy, nutrition assessment, planning and evaluation in the community setting.

NUTR 485 R/685 R NUTRITION RESEARCH AND CONTEMPORARY ISSUES
Lecture+Lab: 1+6  Credit(s): 3
Develop and work through a research problem in nutrition. Discuss contemporary research issues including ethics, research design and grantsmanship. Nutrition majors only. (Major capstone course.) (Formerly NUTR 480/680; implemented Spring 2005.)

NUTR 700 INDEPENDENT STUDY
Credit(s): 1 to 3

NUTR 725 NUTRITION AND HEALTH
Lecture+Lab: 3+0  Credit(s): 3
Nutrition in various disease states. Focuses on research studies and methodology in the current literature.

NUTR 730 MACRONUTRIENTS
Lecture+Lab: 3+0  Credit(s): 3
In-depth review of current research on the functions of macronutrients. Stresses physiologic and biochemical concepts that underlie the metabolic and nutritional relationships of macronutrients.

NUTR 735 R MICRONUTRIENTS
Lecture+Lab: 3+0  Credit(s): 3
Metabolism of micronutrients: absorption, transport, storage, interactions and excretion; historical perspectives, dietary requirements, effects of excesses and deficiencies, role in health and disease.

PUBH 674 EPIDEMIOLOGY IN PUBLIC HEALTH
Lecture+Lab: 3+0  Credit(s): 3
Principles and methods of descriptive and analytic epidemiology with an emphasis on critical examination of current public health research. (Formerly HE 674; implemented Spring 2005.)
PUBH 725 HEALTH AND THE ENVIRONMENT
Lecture+Lab: 3+0  Credit(s): 3
Focuses on health and wellness relationships, ranging from the individual to the global, with emphasis on the environment and its impact on human health. (Formerly HE 725; implemented Spring 2005.)

PUBH 791 SEMINAR IN PUBLIC HEALTH
Lecture+Lab: 3+0  Credit(s): 3
Intensive study and discussion of selected areas in health ecology. Maximum of 9 credits. (Formerly HE 791; implemented Spring 2005.)

STAT 452/652 STATISTICS I
Lecture+Lab: 3+0  Credit(s): 3
Bivariate distributions, covariance and correlation. Methods of estimation. General linear regression analysis, analysis of variance, design of experiments, distribution-free methods. (Formerly MATH 452/652; implemented Fall 2003.)

STAT 755 MULTIVARIATE DATA ANALYSIS
Lecture+Lab: 3+0  Credit(s): 3
Statistical analysis of multivariate data. Multivariate normal and related distributions, multivariate linear regression, canonical correlation analysis, principal components, factor analysis, and discrimination and classification. (Formerly MATH 755; implemented Fall 2003.)

STAT 757 APPLIED REGRESSION ANALYSIS
Lecture+Lab: 3+0  Credit(s): 3
Techniques and applications of linear regression analysis: inference and model diagnostics. Primarily intended for non-math graduate students. (Formerly MATH 757; implemented Fall 2003.)

STAT 758 TIME SERIES ANALYSIS
Lecture+Lab: 3+0  Credit(s): 3
Analytic and computer methods for time series analysis, including the time domain (autocorrelation) and frequency domain (spectral) approach. (Formerly MATH 758; implemented Fall 2003.)

Environmental Sciences Interdisciplinary Graduate Program Assessment Plan
**Mission Statement**

The mission of the UNR Environmental Sciences Interdisciplinary Graduate Program (ES) is to provide training to scientists in environmental processes and environmental health. Training in environmental processes includes a focus on analytical chemistry. Students work on research projects, which range from determining methods of remediation of acid mine drainage, to determining long range transport of trace contaminants in air. Students need to have a fundamentally sound understanding of physical chemical processes and advanced instrumentation for measurement of trace contaminants. The environmental health track focuses on biochemical and cellular toxicology. Special emphasis is placed on the impact of contaminants on humans. Examples of projects in this area include response of tissues to oxidative stress, impacts of selenium on developing embryos and the effects of indoor air contaminants.

**Student Learning Outcomes**

Understanding of the theoretical basis and observational methods for study of contaminants and interactions with the land surface, biota and climate.

<table>
<thead>
<tr>
<th>Student Performance Indicator</th>
<th>Assessment Method</th>
</tr>
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<tbody>
<tr>
<td>Descriptive and numerical solutions to exam questions</td>
<td>Course and graduate exam grades</td>
</tr>
<tr>
<td>Oral presentation in graduate student seminars</td>
<td>Seminar evaluations by faculty and students</td>
</tr>
<tr>
<td>Student opinions on course content</td>
<td>Student evaluations of individual courses</td>
</tr>
<tr>
<td>Independent development of research design and methodologies</td>
<td>Faculty evaluation of dissertation</td>
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</table>

Knowledge of the design and use of field instrumentation, computer models, data analysis and laboratory procedures for environmental chemistry research and monitoring.

<table>
<thead>
<tr>
<th>Student Performance Indicator</th>
<th>Assessment Method</th>
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</thead>
<tbody>
<tr>
<td>Operation of instrumentation and analysis of data in laboratory, field and computer projects</td>
<td>Supervisor and instructor evaluations</td>
</tr>
<tr>
<td>Performance in summarizing research methods</td>
<td>Supervisor and instructor evaluations</td>
</tr>
<tr>
<td>Dissertation content describing research design and analytical methods</td>
<td>Faculty evaluations from dissertation review and defense</td>
</tr>
<tr>
<td>Instruction and team leadership to other scientists or students in field, lab, computer and data analysis tasks</td>
<td>Instructor, supervisor and student evaluations</td>
</tr>
<tr>
<td>Employer opinions during internships and post-graduate appointments</td>
<td>Employer surveys and inquiries</td>
</tr>
</tbody>
</table>
Ability to explain ideas and results through written, numerical, graphical, spoken, and computer-based forms of communication.

<table>
<thead>
<tr>
<th>Student Performance Indicator</th>
<th>Assessment Method</th>
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</thead>
<tbody>
<tr>
<td>Comprehensive Exams</td>
<td>Exam grades</td>
</tr>
<tr>
<td>Oral presentations and examinations</td>
<td>Faculty and student evaluations in student seminars</td>
</tr>
<tr>
<td>Dissertation structure and content</td>
<td>Faculty evaluations from dissertation review and defense</td>
</tr>
<tr>
<td>Lectures and other instructional activities prepared by the student</td>
<td>Faculty and audience evaluations</td>
</tr>
</tbody>
</table>

Adaptability to new avenues of scientific inquiry that offer interdisciplinary and practical applications to commercial and public needs.

<table>
<thead>
<tr>
<th>Student Performance Indicator</th>
<th>Assessment Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application of dissertation results to broader impacts</td>
<td>Faculty evaluation from dissertation review and defense</td>
</tr>
<tr>
<td>Performance in interdisciplinary studies and coursework</td>
<td>Faculty evaluations and course grades from interdisciplinary topics</td>
</tr>
<tr>
<td>Employer opinions during pre-graduation internships or post-graduate appointments</td>
<td>Employer surveys</td>
</tr>
<tr>
<td>Alumni opinions while in post-graduate appointments and other career activities</td>
<td>Alumni surveys</td>
</tr>
</tbody>
</table>

Use of Results
The ES faculty will use the results of the assessment to develop recommendations on changes or additions to course content, curriculum requirements, students recruitment and student advisement. This committee will present their summary and recommendations to the ES graduate faculty for discussion and action. The ES faculty will also be asked to review and approve a plan for future ongoing assessment activities.

Implementation Plan
Data required for the assessment process (course grades, seminar evaluations, supervisor evaluations of research assistants, dissertation review, and defense evaluations, etc.) will be requested of the faculty during the coming semesters. The faculty will also be asked to suggest additional performance measures for graduate research projects and interdisciplinary coursework. The ES will undertake the assessment process during the Fall semester and will report on possible curriculum changes and ongoing assessment methods during the Spring semester. Modifications and additions to the curriculum, recruitment and advisement will be implemented as soon as feasible while continuing to meet the programmatic needs of the students currently working on their degree requirements.
ES Program Budget Summary for Fiscal Year 2006-2007

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>AMOUNT</th>
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<tbody>
<tr>
<td>Professional Salaries</td>
<td>5,000</td>
</tr>
<tr>
<td>Graduate Salaries</td>
<td>34,000</td>
</tr>
<tr>
<td>Fringe Benefits</td>
<td>2,029</td>
</tr>
<tr>
<td>Travel</td>
<td>700</td>
</tr>
<tr>
<td>Operations</td>
<td>3,728</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>45,457</strong></td>
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## SEMINAR SCHEDULE

### Fall 2006

<table>
<thead>
<tr>
<th>DATE</th>
<th>SPEAKER</th>
<th>INSTITUTION</th>
<th>TOPIC</th>
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<tr>
<td>Sept 11</td>
<td>Mark Walker</td>
<td>Dept. of Natural Resources and Environmental Sciences, University of Nevada, Reno</td>
<td>Leptospirosis</td>
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<tr>
<td>Sept 18</td>
<td>Alan Gertler</td>
<td>Atmospheric Sciences, Desert Research Institute</td>
<td>Nitrogen deposition to the Tahoe Basin</td>
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<tr>
<td>Sept 25</td>
<td>Dale Johnson</td>
<td>Dept. of Natural Resources and Environmental Sciences, University of Nevada, Reno</td>
<td>Fire effects on ecosystem carbon and nitrogen budgets</td>
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<tr>
<td>Oct 2</td>
<td>Randall Todd</td>
<td>Nevada State Health Division, Reno</td>
<td>Asian bird flu</td>
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<tr>
<td>Oct 9</td>
<td>Pat Arnott</td>
<td>Department of Physics, University of Nevada</td>
<td>Air quality in Mexico City</td>
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<tr>
<td>Oct 30</td>
<td>Eric Marchand</td>
<td>Dept. of Civil Engineering, University of Nevada, Reno</td>
<td>Role of microbes in biogeochemical cycling of acid mine drainage</td>
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<tr>
<td>Nov 6</td>
<td>James Seiber</td>
<td>Western Regional Research Center, U.S.D.A.</td>
<td>New dimensions in food safety research</td>
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<tr>
<td>Nov 27</td>
<td>Charles Driscoll</td>
<td>Dept. of Civil and Environmental Engineering Syracuse University (Syracuse, NY)</td>
<td>Mercury cycling in Adirondack forest</td>
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<td>Dec 4</td>
<td>Eric Prestbo</td>
<td>Frontier GeoSciences (Seattle, WA)</td>
<td>United States Clean Air Mercury Rule Emission and Air Monitoring; But what about Asian Long-Range Transport to the Western US?</td>
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<td>Dec 11</td>
<td>Lisa Stillings</td>
<td>U.S. Geological Survey, Reno</td>
<td>Selenium cycling in Las Vegas Wash</td>
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## SEMINAR SCHEDULE

### Spring 2007

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<tr>
<td>Feb. 5</td>
<td>Allan Smith</td>
<td>UC Berkeley</td>
<td>Aqueous arsenic effects on children and adults.</td>
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<tr>
<td>Feb. 12</td>
<td>Wei Yang</td>
<td>School of Public Health, University of Nevada</td>
<td>Elements of Epidemiology</td>
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<tr>
<td>Feb. 26</td>
<td>Marc Amvot</td>
<td>Université du Québec</td>
<td>Mercury fluxes in the environment from geochemistry to ecology.</td>
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<tr>
<td>March 5</td>
<td>Chris Pritsos</td>
<td>Nutrition Department, University of Nevada</td>
<td>Environmental Tobacco Smoke</td>
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<tr>
<td>March 12</td>
<td>Scott Slovic</td>
<td>Literature and Environment, University of Nevada</td>
<td>Numbers and Nerves: Information and Meaning in a World of Data.</td>
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<tr>
<td>March 15</td>
<td>John Warwick</td>
<td>Desert Research Institute</td>
<td>Long-term modeling of nutrient dynamics, periphyton growth, and associated dissolved oxygen in the lower Truckee River, Nevada.</td>
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<td>March 26</td>
<td>Dana Loomis</td>
<td>School of Public Health, University of Nevada</td>
<td>Chrysotile Asbestos: Exposure Assessment and Cancer Risks</td>
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<tr>
<td>April 2</td>
<td>Thomas Torgersen</td>
<td>University of Connecticut</td>
<td>Shallow Hydrologic Systems: Biogeochemical Processes, Controls and Coupling</td>
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<tr>
<td>April 5</td>
<td>Joan Rose</td>
<td>Michigan State University</td>
<td>Advancing the art of microbial risk assessment</td>
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<tr>
<td>April 23</td>
<td>Kent Hoekman</td>
<td>Desert Research Institute</td>
<td>Energy and Environmental Issues in the U.S.</td>
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<tr>
<td>April 30</td>
<td>Larry Needham</td>
<td>Center for Disease Control</td>
<td>Principles and Uses of Biomonitoring in Assessing Human Exposure to Environmental Chemicals</td>
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<tr>
<td>May 7</td>
<td>Mark Witten</td>
<td>University of Arizona</td>
<td>Tungsten and the Fallon Leukemia Cluster</td>
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Appendix E

M.S. student publications

Publications with M.S. students as either first or later authors include twenty-nine from 1996—present (Zielinska, Sagebiel et al., 1996; Johnson, Emerson et al., 1997; Tsukamoto, Ward et al., 1997; Ward, Tsukamoto et al., 1997; Zambrowski, Killion et al., 1997; Cahill, Benesch et al., 1999; Cahill, Seiber et al., 1999; Miller, Quashnick et al., 2001; Sherwood and Qualls, 2001; Zielinska, Sagebiel et al., 2001; Benesch and Gustin, 2002; Benesch, Gustin et al., 2002; Gustin, Nacht et al., 2002; Frescholtz, Gustin et al., 2003; Gustin, Coolbaugh et al., 2003; Johnson, Benesch et al., 2003; Miller, Carroll et al., 2003; Sufka and Miller, 2003; Frescholtz and Gustin, 2004; Nacht, Gustin et al., 2004; Stewart and Fritsen, 2004; Tsukamoto, Killion et al., 2004; Flintoff-Dye and Omaye, 2005; Brasel, Cooper et al., 2006)

Bibliography of M.S. student publications:


Doctoral publications
Publications with Ph.D. students either as first or later authors from 1994—present include 129 publications, are listed below (Duraiswami, Farnham et al., 1994; Wilson, Zhang et al., 1994; Alvarez, Buttner et al., 1995; Bonzongo, Chen et al., 1995; David and Seiber, 1995; Seiber, Woodrow et al., 1995; Wilson, Billitti et al., 1995; Woodrow, Honaganahalli et al., 1995; Zehavi, Seiber et al., 1995; Bonzongo, Heim et al., 1996; Chen, Bonzongo et al., 1996; Chen, Bonzongo et al., 1996; David and Seiber, 1996; David and Seiber, 1996; Omaye, Burri et al., 1996; Pritsos and Briggs, 1996; Wilson, Zhang et al., 1996; Wujcik and Seiber, 1996; Chen, Bonzongo et al., 1997; David and Seiber, 1997; Honaganahalli and Seiber, 1997; Honaganahalli and Seiber, 1997; LeNoir, McConnell et al., 1997; Pritsos, Briggs et al., 1997; Seiber, LeNoir et al., 1997; Seiber, Woodrow et al., 1997; Wilson, Zhang et al., 1997; Woodrow, Honaganahalli et al., 1997; Woodrow, LeNoir et al., 1997; Wujcik, Zehavi et al., 1997)(Yang, Jennison et al., 1997; Cidzziel, Hoge et al., 1998; Datta, Hansen et al., 1998; Datta, McConnell et al., 1998; Howard, Briggs et al., 1998; Howard, Ota et al., 1998; Howard, Ota et al., 1998; LeNoir, Aston et al., 1998; McConnell, LeNoir et al., 1998; McConnell, LeNoir et al., 1998; Wujcik, Cahill et al., 1998; Wujcik, Zehavi et al., 1998; Zielinska, Fujita et al., 1998; Briggs and Pritsos, 1999; Briggs and Pritsos, 1999; Cidzziel, Hodge et al., 1999; David, Li et al., 1999; David and Seiber, 1999; David and Seiber, 1999; Honaganahalli and Seiber, 1999; Johannessson, Farnham et al., 1999; LeNoir, 1999; LeNoir, McConnell et al., 1999; Mazzera, Hayes et al., 1999; Netski, Thran et al., 1999; Seiber, LeNoir et al., 1999; Seiler, Zaugg et al., 1999; Stetzenbach, Farnham et al., 1999; Woodrow, LeNoir et al., 1999; Wujcik, Cahill et al., 1999; Chen, Jennison et al., 2000; Chen, Yang et al., 2000; Farnham, Stetzenbach et al., 2000; Honaganahalli and Seiber, 2000; LeNoir, Aston et al., 2000; Lowenthal, Chow et al., 2000; Massey and LeNoir, 2000; McDonald, Zielinska et al., 2000; Zhang and Omaye, 2000; Buttner, Cruz-Perez et al., 2001; Cahill, Thomas et al., 2001; Chen, Omaye et al., 2001; Cruz-Perez, Buttner et al., 2001)(Miller, Herbert et al., 1999; Tsukamoto and Miller, 1999; Cruz-Perez, Buttner et al., 2001; Gertler, Abu-Allaban et al., 2001; Herbert, Hoanhout et al., 2001; Hussein and Brasil, 2001; Mazzera, Lowenthal et al., 2001; Mazzera, Lowenthal et al., 2001; Stetzenbach, Hodge et al., 2001; Tarnay, Gertler et al., 2001; Thran, Hussein et al., 2001; Thran, Hussein et al., 2001; Zhang and Omaye, 2001; Zhang and Omaye, 2001; Zhang and Omaye, 2001; Zhang and Omaye, 2001; Abu-Allaban, Coulomb et al., 2002; Chen, Qualls et al., 2002; Chen, Yang et al., 2002; Farnham, Singh et al., 2002; Hussein, Thran et al., 2002; Mazzera, Lowenthal et al., 2002; McDonald, Zielinska et al., 2002; Neil-Urban, LaSala et al., 2002; Tarnay, Gertler et al., 2002; Brasil, Cooper et al., 2003; Chen and Qualls, 2003; Farnham, Johannessson et al., 2003; Hussein, Thran et al., 2003; Hussein, Thran et al., 2003; McDonald, Zielinska et al., 2003; McDonald, Zielinska et al., 2003; Miller, Carroll et al., 2003; Rogers, Sagebiel et al., 2003; Thran, Hussein et al., 2003; Turner, Rudin et al., 2003; Buttner, Cruz et al., 2004; Marutani and Edirveerasingam, 2004; McDonald, Barr et al., 2004; McDonald, Eide et al., 2004; Stetzenbach, Buttn et al., 2004; Tsukamoto, Killien et al., 2004; Zielinska, Sagebiel et al., 2004; Chen, Qualls et al., 2005; Brasil, Cooper et al., 2006; Chow, Watson et al., 2006; Kounce, Yu et al., 2006; Marutani and Edirveerasingam, 2006; McDonald, White et al., 2006; Brasil, Collier et al., 2007)

Bibliography of Doctoral Student Publications:


Appendix E


Graduate Program in Environmental Science

FACULTY RESEARCH

Dean Adams
My research interests are in the areas of water chemistry, low technology water and wastewater treatment systems, lake and reservoir restoration, land application of municipal sludge, sensitized photooxidation of recalcitrant organic and inorganic species, and new analytical methods development. Water use depends substantially upon the particular inorganic and organic species found in solution. The determination of these species is a fundamental part of establishing how that water may be used. Here and abroad there is always a need for low technology water and wastewater systems which require minimal mechanical equipment and operator expertise. Beneficial use of municipal biosolids for agronomic purposes is also of importance, not only for agricultural gain but to assist in one of the more perplexing and complex problems associated with the very large quantities of biosolids being generated by our wastewater treatment systems.

Sudeep Chandra
Aquatic ecology, food web interactions, native fisheries restoration and conservation, invasive species, contaminant uptake and transfer, stable isotopes, biochemical nutrition.

Judith Chow
Dr. Judith C. Chow has over 22 years of experience in conducting air quality studies and performing statistical data analysis. She directs DRI’s Environmental Analysis Facility where she supervises filter processing and chemical operations and develops cost-effective, yet accurate, methods for aerosol sampling and analysis. Owing to her knowledge and experience, Dr. Chow was invited to present and publish the Air & Waste Management Association’s 1995 annual critical review on aerosol measurement methods. Dr. Chow is the principal author or co-author of more than 100 peer-reviewed publications and more than 150 technical reports. Dr. Chow is a member of the National Academy of Sciences/National Research Council’s Committee on Research Priorities for Airborne Particulate Matter that was formed at the request of Congress to identify the most important research priorities relevant to setting particulate matter standards, to develop a conceptual plan for particulate-matter research, and, over 5 years, to monitor research progress toward improved understanding of the relationship between particulate matter and public health.

Christian Fritsen
As a systems microbial ecologist, Dr. Fritsen studies the transfer of energy and cycling of materials within ecosystems that are mediated by bacteria, algae and protists. His work focuses on how the microbes and their interactions are influenced by the time-varying physical features of their environment. One long-standing area of interests has been on the interaction between seasonal ice dynamics and microbial production in polar ice environments. Such studies provide insights into microbial adaptations, microbial interactions within complex systems, and the possibility of life supporting habitats beyond earth. An emerging area of personal interest also lies in the interactions between a society’s use of nutrients that influences microalgal seasonal production cycles and community structure which, in turn, affect the beneficial uses of aquatic ecosystems. Having these interests mandates that the majority of Dr. Fritsen’s time involves planning, conducting and reporting on field work and laboratory-based studies. Teaching and advising in both undergraduate and graduate programs at the University of Nevada Reno in addition to public outreach seminars and school visitations also allows ample opportunity for obtaining fresh perspectives and youthful energy through interactions with the next generation of scientists and stewards of our environment.

Alan W. Gertler
Dr. Gertler’s research includes both laboratory and field studies of atmospheric chemistry with particular emphasis on the impact of mobile sources on the environment. His research at DRI has included the characterization of factors affecting the rate and mechanism of SO2 and NOx oxidation in the atmosphere, wet and dry deposition processes, studies of chemical processes leading to “gas-to-particle” conversion, the effects of acids and their precursors on materials, fog and cloud droplet characterization, trace analysis of pollutants in air and water samples, and development of quality assurance procedures to insure the accuracy of wet and dry deposition data. In addition, he has investigated discrepancies between observed and predicted automotive emission factors, performed on-road measurements of CO, NOx, speciated NMHC, dioxin, furan, PAHs, and organic and inorganic speciated PM2.5 and PM10 emissions from on-road vehicles. His current research includes measurements and characterization of mobile source PM10 and PM2.5 emissions, assessing the impact of highways on ambient gaseous and particulate pollutant levels, development of new methods to attribute observed PM levels to specific sources, and assessing the magnitude and sources of atmospheric deposition in the Lake Tahoe basin. Dr. Gertler is also the principal investigator for the source attribution component of the USAID sponsored Cairo Air Improvement Project, Hy-
Mae Gustin
My primary research interests are the study of the fate and transport of inorganic contaminants in the environment. My recent work focuses primarily on the environmental fate of mercury and arsenic in the environment. Specific research topics include investigation of natural sources of atmospheric mercury, the role of plants in the biogeochemical cycling of mercury, mercury pollution in the Steamboat Creek-Truckee River watershed, arsenic in the Humboldt River and in ground waters in Fallon, NV. I have also investigated the fate of trifluoroacetic acids and organophosphate pesticides. I am especially interested in the role that the atmosphere and vegetation play as sources, sinks and pathways for cycling of environmental contaminants.

S. Kent Hoekman
Dr. Hoekman is Executive Director of the Division of Atmospheric Sciences (DAS) at the Desert Research Institute (DRI). DRI is a statewide division of the Nevada System of Higher Education (NSHE) that pursues basic and applied environmental research on local, national, and international scales. DAS consists of approximately 50 research faculty, along with 70 technologists, graduate students, post-docs, and other support staff. The Division conducts fundamental and applied research around the world on topics pertaining to emissions, renewable energy, air pollution, meteorology, climatology, aerosol chemistry and physics, and other areas related to atmospheric science. DAS also serves as the institutional home for the Western Regional Climate Center, one of six NOAA-funded regional climate centers in the U.S. As Director, Dr. Hoekman is responsible for all personnel, financial, organizational, and professional activities of Divisional operations. The Division's scientific work is sponsored by over 100 federal, state, local, and private organizations that provide approximately $14 million per year in research grants and contracts. For more information about the Division and its activities, please refer to its web site at http://www.das.dri.edu. At DRI, Dr. Hoekman has also been involved with the process of identifying and protecting intellectual property – and licensing such property to the private, commercial sector. By combining his knowledge of the academic research environment and private business interests, Dr. Hoekman is better able to evaluate the potential viability and value of new technologies.

Prior to joining DRI in 2001, Dr. Hoekman spent over 20 years at Chevron, where his work focused on motor vehicle emissions and their impacts on air quality. Experimental work included detailed characterization of exhaust emission compositions from gasoline-, diesel-, and alcohol-fueled vehicles. Laboratory studies were conducted to investigate how changes in fuel formulation could reduce vehicle emissions and improve ambient air quality. He has served on several technical committees representing the American Petroleum Institute (API), the Western States Petroleum Association (WSPA) the Coordinating Research Council (CRC) and other industry organizations interested in fuels, emissions, atmospheric chemistry and air quality. Dr. Hoekman also has experience in regulatory affairs pertaining to vehicles, fuels, emissions, air quality, and health effects. He has served in technical advisory roles to EPA and was a member of the California Air Resources Board (CARB) Research Screening Committee for five years. He currently serves as a member of the Health Effects Institute's (HEI) Special Committee on Emerging Technologies. Dr. Hoekman's professional interests include environmental impacts of energy production, distribution, and use; development of sustainable energy systems; air quality impacts of vehicle emissions; and impacts of advanced-technology vehicles on emissions and energy use. He is also interested in the interface between politics and environmental science, and in understanding how scientific information can be used to shape public policy.

Chung-hwan Je
Dr. Je's research interests are water quality management and mathematical modeling, contaminated sediments and remediation, automated environmental monitoring, sensor technology applications for environmental protection, web-based intelligent systems for integrated environmental information management, hazardous waste management, GIS application on environmental management, and application software development. His current research includes evaluation and continuous monitoring of VOC gas emissions discharged to the atmosphere in a hazardous waste facility, assessing the impact of environmental release of organic vapors from laboratory operations, and the development of method to determine the optimal water quality parameters in QUAL2E water quality model using a nonlinear GRG optimization algorithm to estimate optimal parameter values.
Appendix F

Dana Loomis
Dr. Loomis research interests cover a spectrum of substantive and methodological topics including Occupational & Environmental Health; Exposure Assessment and Epidemiologic Methods.

Glenn Miller
The transport and transformation of organic and inorganic compounds is the focus of my research. Our laboratory has a long-term interest in the environmental photochemistry of organic compounds, and recently is focusing on the photolysis of pesticides on soil surfaces and in the gas phase. We have developed a heated gas-phase photoreactor which has been very useful in establishing concentrations of pesticides in the gas-phase which can be irradiated with solar simulators. We are also working on a variety of projects related to contamination from mining sites, both from current precious metals mining sites and historic mines. We have developed an anaerobic bioreactor that uses sulfate-reducing bacteria to raise the pH of wastewater and also to remove metals and sulfate from effluent streams. We are also studying the geochemistry of precious metals mining pit lakes, which will be created once many of the large mines close. The long-term impact of these pit lakes on the environment is unknown, and we are investigating methods to predict the eventual water quality in these lakes.

William Murphy
Our laboratory is interested in examining issues in bone marrow transplantation (BMT) and its use for the treatment of cancer and other disease states. BMT, both allogeneic and autologous, is currently used for the treatment of a variety of disease states ranging from aplastic anemia to cancer; but significant obstacles limit the efficacy of this procedure: these include marrow graft failure, graft-versus-host disease (GVHD), immune deficiency following the transplant, and, when used for the treatment of cancer, recurrence of the tumor. Natural killer (NK) cells have been demonstrated to be responsible for mediating the specific rejection of bone marrow cell (BMC) allografts in lethally irradiated mice. However, little is known about the nature of these cells and BMC rejection that leads to marrow graft failure. We have found that NK cell subsets exist that are responsible for mediating the specific rejection of BMC from mice bearing the appropriate MHC molecules. In addition, these NK subsets also play an important role in the normal homeostasis of hematopoiesis, suggesting that it is one of their normal physiologic functions. We are currently examining the differentiation of these various subsets. We are also using activated NK cells as a means of providing additional antitumor effects when BMT is used with tumor-bearing mice. We found that adoptive transfer of NK cells can provide significant antitumor effects while at the same time promote hematopoietic engraftment and prevent GVHD in mice. We are currently examining the mechanism(s) underlying these effects.

Our laboratory has also been examining means to accelerate immune and hematopoietic reconstitution following BMT. This would also be of use in other instances where immune recovery is desirable, such as in AIDS. We have been focusing on the use of neuroendocrine hormones such as growth hormone (GH) and prolactin. They are attractive since they are relatively nontoxic when given systemically and can exert pleiotropic effects. We have found that GH can exert significant hematopoietic growth-promoting effects after in vivo administration. GH can also accelerate immune and hematopoietic reconstitution after BMT in mice. Using a human/mouse chimera model, we have found that these hormones can improve human T cell trafficking and function in vivo. Based on our studies, clinical trials are currently underway evaluating these hormones in patients with AIDS. We are also examining the physiological role of these neuroimmune interactions. CD40, a member of the TNF receptor family of molecules, has been shown to play a critical role in dendritic cell development as well as being a co-stimulatory molecule in T and B cell responses. The ligand for CD40 (CD40L) is present on activated T and NK cells. CD40-CD40L interactions have been demonstrated to be critical for optimal T cell responses and the impairment of these interactions has been shown to foster a tolerogenic state. CD40 stimulation is also capable of inducing production of numerous inflammatory cytokines by monocytes and dendritic cells. Thus, CD40 represents an important molecular target for initiating and/or amplifying nascent immune responses against tumors. We speculated that the enhanced differentiation and function of dendritic cells through CD40 engagement, combined with IL2 administration to stimulate T cell expansion, would act coordinately to enhance both the antigen-presenting and T cell components of the adaptive immune response against cancer. To this end, we have developed a treatment protocol using CD40 agonist antibody and IL2 to promote anti-tumor activity in mice. We are currently exploring the mechanisms involved in this response as well as investigating other potential uses for this immunotherapy.
Alison Murray
Dr. Murray is a molecular microbial ecologist with research interests centered around a common theme of utilizing molecular biological and genomic approaches to describe the diversity of life, understand the evolutionary history, ecological roles, and physiological capacity and capabilities of microorganisms that inhabit environments (or other organisms) several of which are considered to be at the extremes of where life exists. Murray has had long term interests in developing technologies to study microorganisms in the natural environment. Recent work has been dedicated to developing environmental genomics technologies for studying gene expression in organisms sampled directly from the environment, thereby circumventing the need for cultivation. Her research is interdisciplinary in nature, drawing upon oceanography, geosciences, computational biology, and chemistry. She collaborates with a number of scientists with expertise in these fields. Murray’s research has taken her and members of her research group to the Antarctic Peninsula and the McMurdo Dry Valleys of Antarctica, deep sea hydrothermal vents of the East Pacific Rise, and Yellowstone National Park to study the microorganisms inhabiting these diverse, and extreme ecosystems. She has also worked locally in Lake Tahoe to characterize the diversity of organisms throughout the water column and in different periods of stratification through the year.

Robert Nowak
Plant physiological ecology. Current research areas: 1) Invasion, competition, and ecology of exotic annual grasses, especially cheatgrass and red brome, in arid ecosystems. 2) Effects of global changes on vegetation dynamics and on plant ecophysiology and productivity. 3) Dynamics of water and nutrients in native plant communities and their effects on carbon balance, water balance, rooting dynamics, and competition for soil resources. 4) Ecology, physiology, and conservation of rare or endemic plant species. 5) Effects of de-icing compounds on vegetation in the Lake Tahoe basin.

Stan Omaye
Environmental Health—Health effects of air pollutants, environmental tobacco smoke, mercury contamination in Northern Nevada. A multi-disciplinary approach has been used to investigate potential links between health effects and various environmental pollutants. Past or ongoing projects include: 1) Impact of regulatory changes on air pollution and health in Northern Nevada; 2) Maternal, neonate and environmental tobacco smoke; 3) Assessing community needs in environmental health; and 4) Mercury and health effects in Northern Nevada.

Health Promoting Bioactive Compounds—Selected phytochemicals and conjugated linoleic acid. There are a variety of chemicals derived from plant and animal tissue that have the potential for promoting health, when consumed. Nutraceuticals is the term coined for such bioactive compounds, i.e., chemicals found as a natural component of foods or other ingestible forms that have been determined to be beneficial to the human body in preventing or treating one or more diseases. For over a decade, we have been interested in several of such chemicals and are continuing our efforts to understand their mode of action. Many of these compounds have antioxidant properties, thus we have focused on developing a better understanding about how they impact on oxidative stress using test tube models, animal studies, and human trials. Improving Food Safety for Vulnerable Populations of Nevada. Preventing foodborne illness and death remains a major public health challenge and substantially reducing foodborne disease outbreaks is a goal of Healthy People 2010. CDC still estimates that 76 million people get sick, more than 300,000 are hospitalized and approximately 5,000 Americans die each year from foodborne illnesses. Those at risk are the elderly, pregnant women, infants, and young children and those with compromised immune system. Thus, one in every five individuals in the U.S. falls into one of these as-risk categories. Because of Nevada’s growing elderly and young populations and the economic dependency on food service related tourism, we are particularly vulnerable. We are involved in assisting these vulnerable populations through food safety research and education.

Chris Pritsos
Research interests focus on oxidative stress including the production of oxygen radicals, their deleterious effects and biological defense mechanisms. Specific areas of study include the effects of environmental tobacco smoke on workers, protection by antioxidants, and the mechanism of action of several anti-cancer agents.

Jerry Qualls
Ecosystem level ecology, biogeochemistry, how ecosystems develop means of retaining soluble organic nutrients during primary succession, formation of soil organic matter by microbial and chemical transformations, microbial mineralization of humic substances, N cycling in the Mojave desert, Phosphorus cycling in Lake Tahoe, ecophysiology and competitive relationships of the invasive exotic Lepidium latifolium (tall whitetop) and other wetland invasive weeds, wetland biogeochemistry.
Appendix F

John Sagebiel
The major theme of my research has been to investigate sources of pollutants in the atmosphere and understand their impacts on total pollutant load and photochemical oxidant production. One of my goals is to provide the analytical methods, chemical analyses and understanding of the problems and issues surrounding these sources. In this pursuit, I have developed a significant interest in alternative fuels and their emissions and the avoided emissions from replacing fossil fuels. I am also working on the understanding of the abilities of canines to detect various sources and the application of this in environmental research. Lastly, I have experience in solar power and green building as I have built my own home following these principles.

Paul Verburg
My main research interests revolve around the effects of large-scale environmental perturbations such as climate change and increased N deposition on terrestrial ecosystems with an emphasis on soils. Some examples of projects I am currently involved in include (1) effects of interannual climate variability on ecosystem processes in tallgrass prairie; (2) effects of increased N deposition and precipitation on calcite dynamics in Mojave Desert ecosystems; and (3) assessment of urban versus natural source of N and P in a partly developed watershed in the Lake Tahoe basin. In addition to these larger projects I other projects include (1) assessing suitability of Mud Lake Slough for restoration of wetlands; (2) determining potential of Laser Induced Breakdown Spectroscopy as a tool to quantify heavy metal contents in plant material; and (3) determining effects of prescribed fire on soil P transformations.

Mark Walker
Research interests include assessing the health risks posed by nonpoint sources of pathogenic microorganisms, such as Cryptosporidium and Leptospira. I am exploring ways to develop risk assessment tools, including methods to determine presence of pathogens in environmental samples. As State Extension Water Specialist, I work with county and regional faculty to identify priorities and opportunities for Extension involvement in community water resources issues. This includes developing and carrying out training programs for rural water suppliers in Nevada using videoconferencing facilities. Part of this effort is devoted to assessing exposure to elevated concentrations of arsenic in private water wells in Churchill County. With support provided by the U.S. Department of Agriculture’s Cooperative State Research Education and Extension Service and Senator Harry Reid’s office, I am evaluating exposure to arsenic through private wells and examining seasonal trends in arsenic concentration that might be associated with application of irrigation water.

Barbara Zielinska
Dr. Zielinska is a Research Professor and the Director of the Organic Analytical Laboratory (OAL) at the Desert Research Institute. Prior to coming to DRI, she was an Associate Research Chemist for the Statewide Air Pollution Research Center (SAPRAC), University of California, Riverside, where she conducted research on the mechanism of formation of mutagenic derivatives of polycyclic aromatic hydrocarbons under the influence of gaseous atmospheric pollutants. Her current primary research interests include development of measurement methods for organic compounds present both in gas- and particle phases in ambient air and emission sources; atmospheric transformations of organics; and exposure measurements to hazardous air pollutants. Dr. Zielinska served three consecutive terms (from 2000 to 2006) as a member of the US EPA Clean Air Scientific Advisory Committee (CASAC). Currently she is a member of the CASAC Lead and Ozone Review Panels and a co-chair of the CASAC Ambient Air Monitoring & Methods (AAMM) Subcommittee.
## ES Faculty Contact Information

<table>
<thead>
<tr>
<th>Name</th>
<th>Website</th>
<th>Phone</th>
<th>Email</th>
</tr>
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<tr>
<td>Adams, Dean</td>
<td><a href="http://www.cabnr.unr.edu/chandra/">http://www.cabnr.unr.edu/chandra/</a></td>
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<td>(775)784-6221</td>
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<tr>
<td>Chow, Judith</td>
<td><a href="http://www.dri.edu/People/judyc/">www.dri.edu/People/judyc/</a></td>
<td>(775)674-7050</td>
<td><a href="mailto:Judy.Chow@dri.edu">Judy.Chow@dri.edu</a></td>
</tr>
<tr>
<td>Fritsen, Christian H.</td>
<td><a href="http://www.dri.edu/People/cfritsen">www.dri.edu/People/cfritsen</a></td>
<td>(775)673-7300</td>
<td><a href="mailto:Chris.Fritsen@dri.edu">Chris.Fritsen@dri.edu</a></td>
</tr>
<tr>
<td>Gault, Ruth</td>
<td></td>
<td>(775)784-3558</td>
<td><a href="mailto:rgault@medicine.nevada.edu">rgault@medicine.nevada.edu</a></td>
</tr>
<tr>
<td>Gertler, Alan</td>
<td><a href="http://www.dri.edu/People/alang/">www.dri.edu/People/alang/</a></td>
<td>(775)674-7061</td>
<td><a href="mailto:alang@dri.edu">alang@dri.edu</a></td>
</tr>
<tr>
<td>Gustin, Mae</td>
<td><a href="http://www.cabnr.unr.edu/gustin">www.cabnr.unr.edu/gustin</a></td>
<td>(775)784-4203</td>
<td><a href="mailto:mgustin@cabnr.unr.edu">mgustin@cabnr.unr.edu</a></td>
</tr>
<tr>
<td>Hoekman, S. Kent</td>
<td><a href="http://www.dri.edu/People/skho/">www.dri.edu/People/skho/</a></td>
<td>(775)674-7065</td>
<td><a href="mailto:skho@dri.edu">skho@dri.edu</a></td>
</tr>
<tr>
<td>Je, Chung-hwan</td>
<td></td>
<td>(775)327-2249</td>
<td><a href="mailto:cje@unr.edu">cje@unr.edu</a></td>
</tr>
<tr>
<td>Loomis, Dana</td>
<td><a href="http://www.unr.edu/hcs/he/facultypg_files/loomis_d">www.unr.edu/hcs/he/facultypg_files/loomis_d</a></td>
<td>(775)682-7103</td>
<td><a href="mailto:dploomis@unr.edu">dploomis@unr.edu</a></td>
</tr>
<tr>
<td>Miller, Glenn</td>
<td><a href="http://www.dri.edu/idgrad/esh/Faculty/GMiller.asp">www.dri.edu/idgrad/esh/Faculty/GMiller.asp</a></td>
<td>(775)784-6654</td>
<td><a href="mailto:gcmiller@unr.edu">gcmiller@unr.edu</a></td>
</tr>
<tr>
<td>Murphy, William</td>
<td><a href="http://www.unr.edu/med/dept/Microbiology/faculty_murphy.htm">www.unr.edu/med/dept/Microbiology/faculty_murphy.htm</a></td>
<td>(775)784-7599</td>
<td><a href="mailto:wmurphy@medicine.nevada.edu">wmurphy@medicine.nevada.edu</a></td>
</tr>
<tr>
<td>Murray, Alison</td>
<td><a href="http://www.dri.edu/People/alison">www.dri.edu/People/alison</a></td>
<td>(775)673-7361</td>
<td><a href="mailto:alison@dri.edu">alison@dri.edu</a></td>
</tr>
<tr>
<td>Nowak, Bob</td>
<td><a href="http://www.cabnr.unr.edu/nowak/">www.cabnr.unr.edu/nowak/</a></td>
<td>(775)784-1656</td>
<td><a href="mailto:nowak@cabnr.unr.edu">nowak@cabnr.unr.edu</a></td>
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<td>(775)784-6447</td>
<td><a href="mailto:omaye@unr.edu">omaye@unr.edu</a></td>
</tr>
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<td>Pritsos, Chris</td>
<td><a href="http://www.unr.edu/cmbprog/cpritsos-nw.htm">http://www.unr.edu/cmbprog/cpritsos-nw.htm</a></td>
<td>(775)784-9443</td>
<td><a href="mailto:pritsos@unr.edu">pritsos@unr.edu</a></td>
</tr>
<tr>
<td>Qualls, Jerry</td>
<td><a href="http://www.cabnr.unr.edu/qualls/">www.cabnr.unr.edu/qualls/</a></td>
<td>(775)327-5014</td>
<td><a href="mailto:qualls@unr.edu">qualls@unr.edu</a></td>
</tr>
<tr>
<td>Sagebiel, John</td>
<td><a href="http://www.ehs.unr.edu">www.ehs.unr.edu</a></td>
<td>(775)784-1139</td>
<td><a href="mailto:jsagebiel@unr.edu">jsagebiel@unr.edu</a></td>
</tr>
<tr>
<td>Seiler, Ralph</td>
<td></td>
<td>(775)887-7674</td>
<td><a href="mailto:rseiler@usgs.gov">rseiler@usgs.gov</a></td>
</tr>
<tr>
<td>Tsukamoto, Timothy</td>
<td></td>
<td>(775)321-8100</td>
<td><a href="mailto:tsukamoto.tim@gmail.com">tsukamoto.tim@gmail.com</a></td>
</tr>
<tr>
<td>Verburg, Paul</td>
<td><a href="http://www.dri.edu/People/pverburg/">www.dri.edu/People/pverburg/</a></td>
<td>(775)673-7425</td>
<td><a href="mailto:Paul.Verburg@dri.edu">Paul.Verburg@dri.edu</a></td>
</tr>
<tr>
<td>Walker, Mark</td>
<td><a href="http://www.cabnr.unr.edu/walker">www.cabnr.unr.edu/walker</a></td>
<td>(775)784-1938</td>
<td><a href="mailto:mwalker@cabnr.unr.edu">mwalker@cabnr.unr.edu</a></td>
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<td>Yang, Wei</td>
<td><a href="http://hhs.unr.edu/sph/wang_y.pg.html">http://hhs.unr.edu/sph/wang_y.pg.html</a></td>
<td>(775)784-4041 x260</td>
<td><a href="mailto:wyang@nvhd.state.nv.us">wyang@nvhd.state.nv.us</a></td>
</tr>
<tr>
<td>Zielinska, Barbara</td>
<td><a href="http://www.dri.edu/People/Barbara.Zielinska/">www.dri.edu/People/Barbara.Zielinska/</a></td>
<td>(775)674-7066</td>
<td><a href="mailto:barbz@dri.edu">barbz@dri.edu</a></td>
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Appendix H

ES FACULTY RESUMES
(under separate cover)
Appendix I

Graduate Program of Environmental Sciences

Maher, T., M.S.: An Air Quality Study of Nanomaterials in a Manufacturing Setting. Advisor: Stan Omaye
Fay, Lau, M.S.: Identifying the Source of Mercury in Deciduous, Wetland, and Evergreen Plants. Advisor: Mae Gustin
Millhollen, A., M.S.: Mercury Accumulation and Exchange Associated with Grass, Forb and Tree Species. Advisor: Mae Gustin
Paul, Angela, M.S.: Arsenic Characterization within the Lower Humboldt River Basin. Advisor: Mae Gustin
Bowen, L., Ph.D.: Mitochondrial Response to Hypoxia and Assessment of Sub-cellular Directed DNA Repair on Mitigating the Effects of ROS induced DNA Damage. Advisor: Chris Pritsos.
Sufka, E., M.S.: The Photochemical Fate of Polycyclic Aromatic Hydrocarbons derived from Marine Engines in Alpine Lakes. Advisor: Glenn Miller.
Giglini, T., M.S.: Reactive Gaseous Mercury Concentrations and Mercury Flux from Natural, Anthropogenic and Background Settings in Northwestern Nevada. Advisor: Mae Gustin.
Sherwood, Lindsay, M.S.: Stability of Phosphorus Within a Wetland Soil Following Ferric Chloride Treatment to Control Eutrophication. Advisor: Robert Qualls.
Cahill, T., Ph.D.: Determination of Trifluoroacetic Acid in Environmental Samples and Evaluation of its Distribution and Possible Impacts on Sensitive Ecosystems. Advisor: James Seiber.
Fiore, M., M.S.: Quantifying the Dissolved Phase of MTBE and BTEX Exhausted from Marine Engines Lake Tahoe Watercraft. Advisor: Glenn Miller.
Frescholtz, T., M.S.: Assessing the Role of Vegetation as Sources and Sinks of Atmospheric Mercury using Quaking Aspen. Advisor: Mae Gustin.
Martin, Nicholas, M.S.: Coronary Heart Disease and Genetic Polymorphisms in Glutathione-S-Transferase MU and Theta Isoforms and NAD(P)H Oxireductase. Advisor: Chris Pritsos.
## Listing of Active ES Students and their Advisors

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<tr>
<td>Bertrando, Neil A</td>
<td>Qualls, Jerry</td>
<td><a href="mailto:bertran4@tmcc.nevada.edu">bertran4@tmcc.nevada.edu</a></td>
</tr>
<tr>
<td>Garfield, Lynell M</td>
<td>Walker, Mark</td>
<td><a href="mailto:lynellgarfield@sbcglobal.net">lynellgarfield@sbcglobal.net</a></td>
</tr>
<tr>
<td>Glover, Richard D</td>
<td>Miller, Glenn</td>
<td><a href="mailto:environrick@gmail.com">environrick@gmail.com</a></td>
</tr>
<tr>
<td>Markee, Melissa</td>
<td>Gustin, Mae</td>
<td><a href="mailto:markee@unr.nevada.edu">markee@unr.nevada.edu</a></td>
</tr>
<tr>
<td>Moye, John K</td>
<td>Pritsos, Chris</td>
<td><a href="mailto:moyej@unr.nevada.edu">moyej@unr.nevada.edu</a></td>
</tr>
<tr>
<td>Naranjo, Jennifer L</td>
<td>Miller, Glenn</td>
<td><a href="mailto:jim@unr.nevada.edu">jim@unr.nevada.edu</a></td>
</tr>
<tr>
<td>Papiez, Maria R</td>
<td>Potosnak, Mark</td>
<td><a href="mailto:mpapiez@unr.edu">mpapiez@unr.edu</a></td>
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<tr>
<td>Stockinger, Allan J</td>
<td>Miller, Glenn</td>
<td><a href="mailto:stockin4@unr.nevada.edu">stockin4@unr.nevada.edu</a></td>
</tr>
<tr>
<td>Vasquez Baeza, Felipe A</td>
<td>Miller, Glenn</td>
<td><a href="mailto:vasquezb@unr.nevada.edu">vasquezb@unr.nevada.edu</a></td>
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<td>Al-Taani, Ahmed</td>
<td>Miller, Glenn</td>
<td><a href="mailto:altaania@unr.nevada.edu">altaania@unr.nevada.edu</a></td>
</tr>
<tr>
<td>Lyman, Seth</td>
<td>Gustin, Mae</td>
<td><a href="mailto:lymans@unr.nevada.edu">lymans@unr.nevada.edu</a></td>
</tr>
<tr>
<td>Perkins, Lora</td>
<td>Nowak, Bob</td>
<td><a href="mailto:perkin72@unr.nevada.edu">perkin72@unr.nevada.edu</a></td>
</tr>
<tr>
<td>Stamenkovic, Jelena</td>
<td>Gustin, Mae</td>
<td><a href="mailto:jelena@unr.nevada.edu">jelena@unr.nevada.edu</a></td>
</tr>
<tr>
<td>Xin, Mei</td>
<td>Gustin, Mae</td>
<td><a href="mailto:meix@unr.nevada.edu">meix@unr.nevada.edu</a></td>
</tr>
<tr>
<td>Zamzow, Kendra</td>
<td>Miller, Glenn</td>
<td><a href="mailto:zamzowk@unr.nevada.edu">zamzowk@unr.nevada.edu</a></td>
</tr>
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</tr>
<tr>
<td>Bohannan, Theresa L</td>
<td>Chow, Judy</td>
<td><a href="mailto:tbohannan4229@charter.net">tbohannan4229@charter.net</a></td>
</tr>
<tr>
<td>Kapitzke, Sheila E</td>
<td>Verburg, Paul</td>
<td><a href="mailto:kapi0002@hotmail.com">kapi0002@hotmail.com</a></td>
</tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>Azzam, Ihsan</td>
<td>Omaye, Stanley</td>
<td><a href="mailto:azzam@unr.nevada.edu">azzam@unr.nevada.edu</a></td>
</tr>
<tr>
<td>Goetz, Deborah</td>
<td>Murphy, William</td>
<td><a href="mailto:dgoetz@unr.nevada.edu">dgoetz@unr.nevada.edu</a></td>
</tr>
<tr>
<td>Goodrich, Geoffrey</td>
<td>Pritsos, Chris</td>
<td><a href="mailto:goodrich3@unr.nevada.edu">goodrich3@unr.nevada.edu</a></td>
</tr>
<tr>
<td>Nakamura, Yukiko</td>
<td>Omaye, Stanley</td>
<td><a href="mailto:ynakamur@unr.nevada.edu">ynakamur@unr.nevada.edu</a></td>
</tr>
<tr>
<td>Owens, Benjamin</td>
<td>Pritsos, Chris</td>
<td><a href="mailto:bowens@unr.nevada.edu">bowens@unr.nevada.edu</a></td>
</tr>
<tr>
<td>Stone, Richard</td>
<td>Pritsos, Chris</td>
<td><a href="mailto:rstone@unr.nevada.edu">rstone@unr.nevada.edu</a></td>
</tr>
</tbody>
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Strategic Plan for the Interdisciplinary Graduate Program of Environmental Sciences and Health

(note – program name was changed in 2005)

December 8, 2003

I. BACKGROUND
The Interdisciplinary Graduate Program in Environmental Sciences and Health (ES&H) was established in 1994 as a Ph.D. and thesis Master’s degree program. Since that time we have established a highly successful program that is focused on environmental chemistry, and human and ecological toxicology. Students graduating with these degrees have been successful in obtaining excellent jobs in academia, industry and government. At present, 27 students are enrolled in the program with a split of 14 in the Ph.D. program and 13 working towards a Master’s degree. Since inception of the program, 24 students have received a Ph.D. and 26 students have received a Master’s degree. The ES&H program is one of the four interdisciplinary environmental graduate programs associated with the Center for Environmental Science and Engineering and reports to the Graduate Dean and Vice-President for Research.

II. ENVIRONMENTAL CONTEXT
The ES&H graduate program is interdisciplinary, with graduate faculty from the Colleges of Agriculture, Biotechnology and Natural Resources, Human and Community Sciences, Science, Engineering, and the Desert Research Institute (DRI). ES&H offers MS and doctoral degrees in the three tracts of (a) environmental chemistry; (b) ecological toxicology; and (c) human and biochemical toxicology.

The development of the ES&H program occurred as a response to wide interest in the environmental sciences from several faculty members at UNR and DRI. As indicated by the three tract areas, ES&H considers how chemicals move and are transformed in the environment, as well as how these chemicals affect humans, plants and animals. The ES&H program recognizes that environmental science is driven by the discipline of risk assessment, and ultimately, how we reduce risk through environmental laws and regulations. Most countries now place a high priority on protecting human health and the environment from anthropogenic and naturally occurring toxic substances, but we, as a society, have also recognized that these protections need to be implemented in an appropriate manner that reflects the true risks of those substances. The societal response to these risks needs to consider the magnitude of the risk, and be placed in context with other risks and priorities. The ES&H program, similar to similar programs in many universities in the U.S., seeks to conduct research and educate students on how to determine risk by better understanding how chemicals affect those organisms that are valued.

Since the 1960’s, when concerns for the environment became widespread, environmental science and risk assessment has matured into a well-defined discipline. While the general area of environmental studies is indeed broad and covers many of the classical disciplines, the ES&H program has retained a strong basis in quantitative science, and requires a background in chemistry, biology, math and physics.

Over the past 3-4 years, the total number of applicants to the program has remained stable at approximately 15-20 per year, and several more inquiries are made each year to the program. The quality of applicants has also remained relatively consistent, although the quality of students that have been admitted to the program has improved, probably related to the lower number of research fellowships available than in past years. In previous years, we have also had an active graduate student program in Las Vegas, with 3-5 ES&H students each year. However, when the UNLV graduate environmental science program was implemented, the number of students from UNLV has been reduced, and presently we have one Ph.D. student enrolled who is conducting her research at UNLV. While we have enjoyed the interactions with UNLV, the logistics of coursework and managing programs in a statewide program has required additional administrative time.

Enrollment in ES&H has declined from a high of 37 students in about 1998 to presently 27 students in the program. This has largely been a result of the loss of Dr. Jim Seiber who was a primary contributor to the program, as well as the reduction in students at UNLV. As is the case with several graduate programs, the number of students admitted to the program is dependent on the financial support (fellowships) available, rather than the number of applicants. Except in unusual circumstances, we prefer not to admit students into the program unless they have both an advisor, as well as funding support for the stipend and research. As we increase the number of actively participating faculty in ES&H, we anticipate that the enrollment will return to 35-45 students.
We have noted a strong increased interest in ecological toxicology, although the faculty expertise in this area needs to be increased. We also have observed an increase in the interest in microbial ecology, and new faculty at DRI, environmental engineering, and NRES are contributing in this area. As is the case for all of the interdisciplinary graduate programs, maintaining an active group of participating faculty is critical for the quality and success of the graduate training that is provided. Unlike departments, the interdisciplinary programs do not have faculty that are assigned to the program and faculty are not evaluated by their involvement in the programs. As such, interdisciplinary programs rely on faculty who see sufficient benefit from participating in the program to the extent that they are not only willing to train graduate students, they are also willing to volunteer their time to promote the success of the program.

The faculty listed on the Environmental Sciences and Health faculty list includes a total of 40 faculty. Most of these have advised students since the program was initiated. However, the list of active faculty during the previous three years who have advised students is a subset of the longer list and has included four members from the Natural Resources and Environmental Science Department, two from Nutrition, one from Environmental Engineering and four from the Desert Research Institute (Atmospheric Science and Biological Sciences). Approximately 20 additional faculty, primarily from these departments have served on graduate committees, and are available to advise graduate students.

Graduates from the program at the MS level have entered the work force in private and governmental positions, as well as continued on in graduate school. Many MS graduates from the program have gone on to successfully complete doctoral degrees at other institutions.

At the doctoral level, students from UNR are placed in academic positions (Washington State University, UNR, UNLV) plus several postdoctoral appointments or a variety of state and federal positions (USGS, DOE, USDA, California State Agencies) as well as a variety of consulting positions.

For both our MS and Ph.D. graduates, finding high quality positions has not been a problem.

III. PROGRAM VISION AND GOALS

The ES&H Graduate Program vision is to

Develop the strongest interdisciplinary graduate program in Environmental Sciences and Health in the western United States and prepare graduate students for challenging positions in academia, government and private industry to protect human health and improve environmental quality.

The general goals that the program identifies include the following:

a. Working with a variety of departmental and interdisciplinary programs, maximize the educational and research opportunities for graduate students by increasing the number of faculty participating in the program, particularly in critical program areas.

b. Maintain a high quality instructional program, working in cooperation with departments and colleges that offer the courses.

c. Improve the administration of the ES&H graduate program and increase involvement of faculty and students.

d. Provide graduate students with the tools necessary for excelling in graduate school.

e. Promote the internal and external visibility of the program and increase the number of graduate student to 35-45.
IV. OBJECTIVES AND STRATEGIES ASSOCIATED WITH PROGRAM GOALS

The program goals indicated above will be accomplished by a combination of strategies and activities listed below.

Maximize the educational and research opportunities for graduate students.

**Objective: Increase the number of participating faculty in the ES&H Graduate Program**

We will work with various colleges and departments to secure faculty in the following areas:

- **Ecological toxicology:** This component of the ES&H program is the single highest priority for enhancement. While both the departments of Biology and Natural Resources and Environmental Science are presently advertising positions in aquatic ecology, we have not been successful in convincing either department to focus these faculty hires on ecological toxicology, although individuals with those interests may still be hired in either of these two positions.

- **Human nutrition/toxicology and epidemiology:** We will continue to work with the Nutrition department on hires in these areas, and expect that within two years, one or both of these faculty can be hired. In addition, we will be approaching the medical school to hire a toxicologist in the pharmacology department, who can both fill the medical education role of this area, but also contribute to the ES&H program needs. While needed, we are not highly optimistic that this position will be forthcoming.

- **Environmental chemistry:** Discussions with the Chemistry Department have been initiated to hire an environmental/analytical chemist, who would both take a lead role for the undergraduate major in environmental chemistry, but also contribute to the ES&H graduate program. The mutual need for this position support and optimistic expectation that this position will be available within two years.

As is the case with other interdisciplinary graduate programs, we have been frustrated with the difficulty in influencing departments to work with us to obtain faculty who will actively participate in ES&H. This lack of ability to obtain critical faculty in appropriate areas remains a significant weakness of the interdisciplinary programs. While the recently proposed Institute for the Environment may ameliorate this situation, we note the substantial problems with influencing the recent positions for the aquatic ecologist position in NRES. Several of the interdisciplinary program directors have concluded that this problem will not be solved until FTE are granted to the interdisciplinary programs to be used for negotiating with various departments to hire faculty in those departments. Administrative procedures need to be developed that allow interdisciplinary program directors the ability to participate actively in selection of faculty that may affect these programs.

**Objective: Work cooperatively with the Master’s in Public Health (MPH) Program to mutually enhance human risk assessment and toxicology research and teaching efforts.**

In the past year, faculty have met with the leadership of the MPH program to discuss how cooperative efforts can mutually enhance both programs. Plans for 2004-2005 include the following:

- Work towards the development of a program that would allow a student to both complete a Ph.D. in ES&H and at the same time receive an MPH degree. We have concluded that the course work has substantial overlap, and students could complete programs in public health and toxicology simultaneously.

- Work towards hiring faculty that are mutually beneficial to both programs. This includes increasing our faculty expertise in toxicology, risk assessment, epidemiology and biostatistics.

- Support initial discussions to develop a School of Public Health and determine how ES&H can best work in concert with this administrative unit to maximize the benefits to graduate students.

- Increase the interaction by continuing joint seminars of mutual interest.
Maintain a high quality instructional program.

Objective: Review and revise the ES&H curriculum during 2004

We need to examine each of the courses being taught that are presently part of the ES&H curriculum for quality and relevance to the program. This will be accomplished in the first quarter of 2004. With the addition of several environmental microbiology faculty at UNR and DRI, we will examine increasing our strength in this area, particularly as it relates to molecular biology. Faculty with expertise in environmental microbiology in NRES, environmental engineering and DRI are particularly noteworthy. Since all of the interdisciplinary graduate programs rely on departments to provide courses needed for the graduate programs, the programs need to work closely with those departments to ensure that the appropriate courses are taught. Following the curriculum review, discussions with associated departments will hope to resolve the unmet needs that may surface. Some of this discussion will be aided when the new Institute for the Environment is established.

Objective: Increase the funding, and reliability of this funding, for the interdisciplinary environmental programs to hire instructors, particularly from DRI, to teach critical courses.

Prior to 2002, the Center for Environmental Science and Engineering had funds to hire DRI faculty (and others) to teach critical courses. During the budget problems of that year, the funding was completely swept, and the interdisciplinary environmental programs do not know in advance what the funding level will be, and thus have difficulty in planning for critical courses. This funding should be in the range of $80K to $100K each year so that the directors can plan for needed courses to be taught. The DRI faculty are a critical component of three of the four interdisciplinary programs and are a very valuable resource for graduate education.

Improve the administration of the ES&H graduate program.

Objective: Develop and maintain a better committee structure for the graduate program, including participation of graduate student representatives.

Use of participating faculty for governance of the program needs to be improved. Committees for curriculum, admission and comprehensive exams need to be utilized more effectively. This will both improve the governance of the Program, but also improve the internal visibility and advocates for the Program.

Objective: Clarify the administrative time for all of the interdisciplinary program directors.

The time requirement for administration of the interdisciplinary programs by the directors has been significantly increased in the past two years, do to increased reporting and planning requirements. While increased reporting and assessment is very important, it comes at a cost to other areas, including reduced time for interaction with students, less time for teaching and less time for research. The home departments of the directors carry the burden for the majority of their salaries, and the chairs of some of these departments see the increase in program director responsibilities as an impact on the departmental programs, and are responding by increasing the teaching loads for program directors. A clear policy is required from the graduate school that will establish the assignments for program directors in their home departments. The ES&H program director, working with other interdisciplinary programs, will advocate the development of a clear policy for how the program directors are evaluated and how much administrative time is allocated for being a program director. The ES&H program also will be reviewing the program director and developing a plan for a change in program leadership.

Administration of the interdisciplinary graduate programs may undergo changes in the next year with the advent of the Institute for the Environment. This may resolve some of the issues of how program directors and the programs are managed.
Provide graduate students with the tools necessary for excelling in graduate school, including increasing the stipends.

**Objective: Increase the amount and number of stipends available to attract the best quality graduate students.**

Stipends need to be increased to a minimum of $18,000 per year in order to provide students with funds required to support themselves. Also, only one stipend is presently available each year to attract incoming graduate students in the ES&H program. The primary source of funding for ES&H students is from research fellowships. One additional fellowship from the graduate school is needed. Additionally we will apply for at least one federal training grant in 2004. We will also seek out opportunities to support students with teaching assistantships in cooperating departments.

**Objective: Increase the ability of graduate students to participate in the governance of the graduate program.**

Graduate students need to be appointed for each of the committees, as well as having a formal graduate student organization from which issues can be brought to the faculty.

Improve the internal and external visibility of the program.

**Objective: Offer additional public seminars that have a wide interest.**

Although we currently have a graduate seminar series each semester, we plan to develop a public seminar series, funded through an outside funding source, that will offer speakers of particular interest to the UNR students, faculty and staff and the public on issues related to the environment and public health. This can be done in cooperation with other interdisciplinary and departmental programs.

**Objective: Evaluate and revise the ES&H web site to improve the visual and information contained in the web site.**

The web site is presently the single largest recruiting tool for the program. During 2004 we will enlist the aid of UNR web staff to improve the web site in order to maximize the utility for attracting graduate student interest. We presently also use a national graduate school web site to attract students.

**V. Resources**

The ES&H graduate program presently receives almost all of the resources from the Office of the Vice-President for Research. Additional teaching funds are presently supplied by the Provost’s office for hiring DRI faculty to teach courses, although these funds are not allocated in a manner that allows planning for courses on a year to year basis.

The ES&H budget in 2006-2007 consists of the following:

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graduate Stipend</td>
<td>$17,000</td>
</tr>
<tr>
<td>Program Coordinator (Graduate Student)</td>
<td>17,000</td>
</tr>
<tr>
<td>Fringe for Stipends</td>
<td>680</td>
</tr>
<tr>
<td>Tuition</td>
<td>1,137</td>
</tr>
<tr>
<td>Director Stipend</td>
<td>5,000</td>
</tr>
<tr>
<td>Operations (Seminars, advertisement)</td>
<td>3,140</td>
</tr>
<tr>
<td>Travel</td>
<td>1,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$45,457</strong></td>
</tr>
</tbody>
</table>

Note: The ES&H program has, for the past 7 years used a graduate student (generally from a different program) to serve in the coordinating role for the program. This has worked very well, in that the persons hired for this job have been very good. However, this has also resulted in new program coordinators every two years, or less, and requires retraining of new staff.
VI. TIMELINE FOR ADDRESSING STRATEGIC GOALS

2003-04

Goal 1.
- Working with a variety of departmental and interdisciplinary programs, maximize the educational and 
  research opportunities for the graduate students by increasing the number of faculty participating in the pro-
  gram, particularly in critical program areas.
- Work with the Biology and Natural Resources and Environmental Science departments on the searches for 
  the aquatic ecologists in the hope that the persons hired will be interested in and support the ES&H pro-
  grams. (note: under the present structure, program directors can only hope, since they do not have much 
  ability to influence the specific positions)
- Work with the MPH faculty to increase the faculty hires in areas of mutual interest.

Goal 2.
- Maintain a high quality instructional program for the program, working with associated departments and col-
  leges that offer the courses.
- Review the ES&H curriculum and make appropriate adjustments to improve the course offerings.
- Work with other interdisciplinary graduate programs to increase funding to support teaching efforts of DRI 
  faculty. Ensure that a budget is established that can provide the necessary funds in advance so that courses 
  can be planned a year in advance.

Goal 3.
- Improve the administration of the ES&H graduate program, as well as the other interdisciplinary graduate 
  programs, to deliver the best quality program.
- Improve the committee structure of the ES&H program to improve faculty involvement by developing a 
  stronger committee structure.
- Advocate the establishment of clear job descriptions and faculty allocation for graduate program directors.
- Conduct an outside assessment of the graduate program, as per the schedule from the Provost’s office.

Goal 4.
- Provide graduate students with the tools necessary for excelling in graduate school, including increasing the 
  stipends.
- Submit at least one training grant proposal.

Goal 5.
- Promote the internal and external visibility of the program.
- Develop a better relationship with the UNR Foundation and work with them to develop funds for the pro-
  gram, as well as promote the program to the wider public.
- Identify a funding source for public seminars.
- Improve the ES&H website.
Most of the efforts planned for next year will need to be continued the following years. Funding is a critical component, and we need to increase the amount of support available for graduate students and faculty to serve as advisors and instructors.

VII. Performance Indicators

Working with a variety of departmental and interdisciplinary programs, maximize the educational and research opportunities for the graduate students by increasing the number of faculty participating in the program, particularly in critical program areas.

- Number of faculty that are advising graduate students
- Specific faculty hires in critical areas of ES&H (e.g. eco-toxicology, toxicology, environmental chemistry)
- Success in development of a cooperative ES&H Ph.D. and MPH degree program.

Maintain a high quality instructional program for the program, working with associated departments and colleges that offer the courses.

- Quality and extent of course offerings
- Funding for DRI instruction

Improve the administration of the ES&H Graduate Program, as well as the other interdisciplinary graduate programs, to deliver the best quality program.

- How well are the committees functioning?
- Are student representatives participating?

Provide graduate students with the tools necessary for excelling in graduate school, including increasing the stipends.

- Have training grants been submitted?
- Have stipends been increased?
- Is there an ES&H student organization?

Promote the internal and external visibility of the program.

- Has a public seminar series been funded and established
- Has the web site been improved
- Are the incoming students GRE and GPA scores improved?
- Are the numbers of applicants increasing?

Submitted by
Glenn C. Miller, Professor and Director
Graduate Program in Environmental Sciences and Health