MESA STATE COLLEGE

AY 2007 – 2008 Program Review

Environmental Science

A. Introduction

1. Overview

Environmental Science is the study of the relationships among humans, other organisms, and the physical environment, with an emphasis on the impacts of human activities. Technology, when used wisely, contributes to the solution of current environmental problems and the prevention of new problems.

Our emphasis in the Environmental Science and Technology (EST) program is on understanding, protecting, and restoring air, water, land, and ecosystem resources. Students graduating with the Bachelor of Science in Environmental Science and Technology complete one of the following three concentrations:

- Environmental Restoration and Waste Management: The focus in this concentration is on preparing students for employment in the environmental services profession, with an emphasis on pollution prevention, pollution control, and cleanup of contaminated sites.

- Environmental Science: Here we emphasize the science, protection, and restoration of natural resources. This concentration is designed for those students who want to pursue careers in ecosystem restoration or graduate study in environmental science.

- Environmental Science Education: Students who complete this concentration along with the education courses required for teacher licensure are prepared for teaching general and environmental science in middle school and high school. In addition to giving students a basic background in biology, chemistry, physics, and geology, we emphasize the use of environmental topics as a framework for integrating the range of science topics and Colorado content standards covered at each grade level.

Opportunities for field work are abundant in the Grand Junction area, with its surrounding public lands and water resources, and a large portion of the program is devoted to field work. The faculty has broad expertise, enabling our students to gain experience in a wide variety of areas. Class sizes are small, leading to quality interactions with the faculty.

Class projects are widely used in our program. Students learn to collect data, analyze and interpret their data, and report their conclusions and recommendations. We initiate this effort in the first course for majors, then continue using projects in later courses with progressively more complexity and higher expectations. Several examples of class projects are shown below.

- ENVS 110 Environmental Science and Technology I—Students perform a study on the impacts of an invasive species (tamarisk) on biodiversity. Students are led step by step through the process of writing a scientific paper based on data collected on a Saturday field trip. Students learn how to display data and perform statistical tests.

- ENVS 200 Field Methods in Environmental Science—Students are given the equipment and a general question to answer (e.g., what is the impact of salty soils on plant growth?) then design their own experiments and perform their analyses. Students present their results in the form of a poster.

- ENVS 313 Characterization of Contaminated Sites—Students plan and implement a study of lead contamination in soil at a nearby shooting range.

- ENVS 331 Water Quality Lab—Students conduct an assessment of the health of aquatic systems and potential for pollution in the nearby Plateau Creek watershed.

- ENVS 360 Fire Ecology—Students conduct independent projects in a nearby, recently burned pinyon-juniper woodland and present their results in the form of a poster.

- ENVS 455 Restoration Ecology—Students produce a detailed restoration plan for a local area based on their own field observations and measurements of soil and vegetation. The outcome is a report and a presentation for the class.

- ENVS 460 Fire Management— Students conduct a wildfire hazard assessment of a local neighborhood and write a Community Wildfire Protection Plan (CWPP) similar to those done by communities wishing to receive federal assistance with fire mitigation.

Projects are the heart of our Capstone course, which all majors must take in the senior year. Students work in groups of three or four to complete semester-long projects for off-campus organizations, allowing them to gain hands-on experience with planning and implementing a project, tracking progress, and presenting results. A few examples from recent years are shown below, with clients in parenthesis.

- Delineation of a wetland along a proposed trail corridor (Riverfront Commission)

- Evaluation of storm water management practices at natural gas drilling pads (City of Grand Junction)

- Tamarisk removal and establishment of a post-removal recovery study area (Colorado Division of Wildlife)

- Development of a GIS data base for abandoned mine sites in the Gateway area (Bureau of Land Management)

- Investigation of an unlined pond as a source of selenium contamination in surface water (U.S. Geological Survey)

- Investigation of hydrocarbon contamination at a local site (Walsh Environmental).

We believe that student participation in applied research projects is an important supplement to the education a student receives through normal classroom, lab, and field activities. Thus, each of our faculty members is engaged in applied research projects in which EST students participate. Examples of these projects include:

- Revegetation experiments in the Colorado National Monument and the McInnis Canyons National Conservation Area
- A study of the fire history of the Colorado National Monument
- Closure and reclamation of abandoned uranium mine sites
- Evaluation of stream condition in a BLM study area
- Riparian improvements at the Uravan Superfund Site
- A bench-scale field test of a bioreactor for removal of selenium in water
- Study of a local pond suffering from repeated fish kills

2. History

The precursors of our EST program date back to 1989, when an Associate of Applied Science in Environmental Restoration Engineering Technology was created through a joint effort between the Mesa State College Department of Computer Science, Mathematics, and Engineering and UNC Geotech, Inc., the operating contractor at the U.S. Department of Energy Grand Junction Projects Office. Geotech and the Department of Energy supplied considerable early support for the program. Through spring 1991, all instructors for courses in the program were provided by Geotech. The Department of Energy provided operating funds totaling $200,000 for the first five years of the program. The Environmental Restoration Engineering Technology program was designed to train students to become technologists capable of supporting engineers and scientists engaged in addressing contaminated sites and managing regulatory compliance, with an emphasis on hazardous waste.

Not long after the establishment of the Environmental Restoration Engineering Technology degree, both students and employers expressed a desire for a four-year degree that would build on the two-year degree. In response, a Bachelor of Science in Environmental Restoration and Waste Management was offered beginning in fall 1993. This four-year degree program continued the emphasis on contaminated sites and regulatory compliance, with the addition of advanced courses as well as more extensive and demanding support courses.

During the late 1990's, an increasing number of students expressed a preference for a track dealing with the protection and restoration of natural resources in addition to pollution cleanup and prevention. We responded to this need by creating the Bachelor of Science in Environmental Science and Technology. The new program included the old Environmental Restoration and Waste Management curriculum as a concentration along with a concentration in Environmental Science and a concentration in Environmental Science Education. Two faculty resignations allowed us to add expertise in ecology and ecosystem restoration in support of the new Environmental Science concentration. Significant improvements have been made to the curriculum in that concentration as a result of our new expertise.

B. Program goals and objectives

The fundamental goal of our program is to produce graduates with a sound understanding of environmental science and the ability to contribute to the resolution of environmental problems. Our approach to this goal is to establish a foundation of scientific knowledge through core courses in the traditional disciplines of biology, chemistry, geology, mathematics, and statistics. We build on this foundation in core environmental science courses, in which students learn environmental science as an interdisciplinary application of the traditional sciences.

Our fundamental goal is achieved by meeting a number of objectives. We seek to produce students having:

- Basic knowledge in the traditional disciplines that contribute to environmental science
- Advanced knowledge in environmental science
- The ability to communicate effectively their understanding of environmental science orally and in writing
- The ability to think critically and analytically
- The ability to synthesize concepts from multiple disciplines in the development of s olutions to problems that are inherently interdisciplinary
- The ability to work effectively both independently and as part of a team
- The ability to use technology appropriate to the selected concentration (e.g., field and laboratory instrumentation and equipment, computer software for processing scientific data, educational technology)
- The ability to recognize non-technical issues that contribute to environmental problems

We also seek to provide non-majors and members of the local community with the opportunity to enhance their insight into the wide range of environmental issues affecting our quality of life on local, national, and global scales, and thereby create a better-informed public.

C. Need for program

1. General considerations

Why should Mesa State College offer a Bachelor of Science in Environmental Science and Technology?

Perhaps the most fundamental reason is to fulfill the College's liberal arts and sciences mission. Whether it is manifested through the EST degree program, general education courses taught by EST faculty, seminars, committee work, or informal conversation, the presence of a strong scientific mindset is one of the key elements of intellectual life in the liberal arts and sciences college. Our EST degree allows the College to retain a highly educated, accomplished faculty for general education science courses who can provide not only a specialist's insight into environmental problems but also a well-developed perspective on the larger scientific endeavor and its impact on our society.

The EST program contributes to efforts to maintain our nation's expertise in science and technology. Reports from government agencies, think tanks, professional associations, and researchers point to an apparent decrease in the number of American students pursuing degrees in science, and perhaps a decrease in the abilities of the graduates as well. We believe that our role in reversing this trend is to attract students to science with programs displaying great vitality, and to produce top-notch graduates through rigor and challenge.

Although the modern era of environmental protection and restoration is thirty years old, we continue to face an array of complex, challenging problems. These problems range from the local scale, such as a polluted mine site, to the global scale, such as resource use that affects our land, air, water and ecosystems. If we are to maintain and improve the quality of life for current and future generations, we must respond to these problems with timely and effective solutions. Our program prepares students to be part of the solution to these environmental challenges.

As detailed in Section E.5, our graduates do find employment in the environmental profession. Our program thus plays a role in meeting the needs of business and industry—locally, regionally, and nationally. The success of our graduates provides recognition for the college and enhances its standing both within and outside of the service region.

2. Enrollment and graduation rates

The numbers of majors and graduates during the review period are shown below.

	2002-03	*2003-04*	*2004-05*	*2005-06*	*2006-07*
Majors	93	98	89	90	73
Graduates	11	13	8	16	9

The number of majors has decreased over the last four years. For reasons that we don't yet understand, we recruited only two or three people as majors out of each of two successive offerings of our introductory course for majors (ENVS 110 in spring 2006 and fall 2006). It must be noted that historically we have found the numbers for majors to be somewhat unreliable. A significant number of students who never enroll in our classes appear on the list of majors. We generally find that most of the students who take ENVS 110 and continue on as majors do complete the program. Those that don't complete the program are typically tripped up by the required chemistry and math courses. This isn't surprising, given that many of the students attracted to our program do not have strong high school science backgrounds and, prior to declaring the EST major, haven't considered themselves to be candidates for a science degree.

The number of graduates shows significant fluctuations from year to year. In spite of the year-to-year fluctuations, the number of graduates seems to be holding steady at an overall average of about eleven. Fourteen people are on-schedule to graduate in the current 2007-08 year. In any given year, no more than one to three students are completing the concentration in Environmental Restoration and Waste Management; the rest are in the Environmental Science concentration. During the peak years of the predecessor program in Environmental Restoration and Waste Management, we graduated eighteen to twenty students each year. Given that we modified the program emphasis in response to a shift in student interest, the lower number of graduates for the current program is a disappointment. However, those students who do graduate are successful at landing jobs in the environmental profession or getting accepted into graduate school, as described in Section E.5.

D. Resources

1. Unique characteristics influencing the need for resources

There are two program characteristics not widely shared on campus that influence our need for resources. One is the emphasis on field work, which leads to considerable use of College-owned and commercially rented vans. In a typical year we have $???? in transportation costs.

A second characteristic related to field work and applied research projects is a significant reliance on equipment, much of it requiring replacement on a cycle ranging from three years to ten years, with some equipment items costing between $10,000 and $100,000. These expenditures are discussed in more detail in Section D.6, below.

2. Faculty and staff

All of our current tenured and tenure track faculty have Ph.D.'s in disciplines related to environmental science. We currently have two tenured professors and one tenure-track professor. A listing of full-time faculty present during the review period is shown below with rank, degree, dates of service, and status.

Full-time faculty

Deborah Kennard Assistant Professor	Ph.D. Botany	2005 to present	tenure track
Tamera Minnick Associate Professor	Ph.D. Ecology	2002 to present	tenured
Russ Walker Professor	Ph.D. Chemistry	1993 to present	tenured

Faculty from other programs who have taught EST courses

Andres Aslan Professor	Ph.D. Geology	1999 to present	tenured
Gigi Richard Associate Professor	Ph.D. Civil Engineering	2002 to present	tenured

We often have the need to employ local professionals as part-time instructors. We are fortunate to have had the services of eight such people during the review period. One of these people has a Ph.D., two more have M.S. degrees, and all have between 10 and 35 years of professional experience.

3. Physical facilities

Classroom-based coursework is conducted mostly in Wubben Hall, which was renovated in 1998. All classrooms are outfitted with computers containing CD drives, network and internet access, videocassette players, data projectors, and projection screens. DVD players are available on request through Media Services. Electrical outlets are available for students who wish to use laptop computers in class. These classrooms are shared with other programs.

Rooms dedicated to the EST program are located on the third floor of the Science Laboratory Building, which was new in 1997. The centerpiece of the EST facilities is an ~1100 square foot room used for lectures and presentations as well as lab activities and project work. The room is equipped with the same technology described in the preceding paragraph and comfortably fits ten to twelve two-person, movable tables. Three additional computers stationed in the room are used by students for in-class exercises and after-class assignments. The lab capabilities of the room include the movable tables, bench space, storage space, a fume hood, two drop-down snorkel-style fume hoods, three sinks, gas outlets, and a still and deionizer for water.

Two adjacent rooms are part of the EST facilities. One is a ~540 square foot room dedicated to faculty and student projects. This room is equipped with a fume hood, two sinks, gas outlets, and two computers. Several of our larger, non-portable pieces of equipment are used here. The second is a ~270 square foot room set up as a chemistry lab, with a sink, fume hood, two snorkel hoods, bench space, storage space, and gas outlets.

We also have ~730 square feet of space located on the ground level of Wubben Hall, next to the loading area, that we use as a storeroom for field equipment and as a staging area for field work. In addition to storage space and bench space, this room includes a large sink and a shower.

We currently house our soils lab activities in a small, College-owned house one block away from campus at 940 Elm Avenue. There are no special facilities in this building, but it provides a useful space for soil processing operations that may be too dirty and dusty to do on a routine basis in any of our other spaces.

4. Instructional equipment

We believe that our equipment collection is a very good reflection of the equipment that is used most commonly in the environmental profession. All of this equipment is used by students.

Laboratory-based equipment includes the following:

- Perkin-Elmer Optima 2000 inductively-coupled plasma atomic emission spectrometer for analysis of dissolved metals
- Spectrace x-ray fluorescence spectrometer for elemental analysis of solids
- Dionex D-120 ion chromatograph for analysis of anions
- Spex 7000 microwave digestion system for preparation of soil samples
- Hach BOD-Trak for measurement of biochemical oxygen demand
- Hach BOD incubator
- constant-temperature refrigerator
- drying oven
- analytical balance

Our field equipment includes:

- pH meters
- turbidity meters
- various chemical test kits
- measuring tapes and beaded cable
- waders
- compasses
- tree corers
- conductivity meters
- a dissolved oxygen meter
- water velocity meters and wading rods
- nets for collecting aquatic insects
- a 2-person boat with trolling motor
- clinometers
- fire weather kits

- sanders
- spring scales
- double-ring infiltrometer
- pressure chambers for measuring plant water status
- time domain reflectometer for measuring soil water content
- magnifying lamps
- portable balance
- calipers
- infrared gas analyzer for measuring photosynthesis
- meter for ammonia and nitrate analysis

5. Library

The EST faculty is mostly satisfied with the relevant library holdings. A book-buying budget averaging ~$2100 per year has allowed us to acquire a good collection of books that support the EST curriculum. In-house holdings of relevant periodicals are not very extensive, but we do have on-line access through the library to considerably more journals. The EST faculty wishes that we had access to additional on-line journals and a more extensive list of back issues.

The analysis of library holdings conducted by the library staff is shown in Appendix 3.

6. Unique sources of revenue and expenditures

We receive an annual allocation from the College for equipment, supplies, and faculty travel. Fees to cover van rental are collected from students enrolling in lab sections and in courses that customarily include field trips. A limited amount of the funding that we have received from outside organizations for specific projects contributes to our routine program operations, either through the availability of project equipment for other uses or from unspent grant funds. We have also been fortunate to receive donations totaling $20,000 through the family of a recent graduate. This donation has gone a long way towards keeping our equipment collection current.

An expenditure not widely shared on campus is the cost of maintaining and eventually replacing major equipment items—a microwave digestion system, ion chromatograph, x-ray fluorescence spectrometer, and inductively-coupled plasma atomic emission spectrometer. In general, equipment of this nature has a lifetime of no more than ten years, and often less. The youngest of these items is seven years old. The first three items are already obsolete in the sense that the manufacturer is no longer producing replacement parts. Service calls cost a minimum of about $3,000 without including the cost of parts and extensive labor. Our most promising avenue for replacement is through grants (the source of the original purchase funds), but success is not certain.

E. Effectiveness

1. Accreditations

There are no organizations that offer accreditation for Environmental Science programs.

2. Changes since the last program review

The present review is the first review conducted for the Bachelor of Science in Environmental Science and Technology. Because the proposal for the current degree was being evaluated at the time that the original four-year degree was scheduled for review, the Office of State Colleges waived the review of the original four-year program.

3. Assessment of student achievement

Our formal efforts in program assessment began only in 2003 and thus we do not have a long track record to serve as a basis for evaluation. Our most recent assessment was from August 2005 to May 2006, and results are discussed below. Our efforts center on four desired outcomes:

1. Students show a strong foundation in understanding the behavior and interactions of physical, chemical, and biological components of the environment.

2. Students demonstrate the ability to plan, implement and communicate the results of an environmental project.

3. Students demonstrate knowledge of historical and current approaches to environmental problems and controversies.

4. Students are prepared for a job or advanced study in the environmental field.

To assess these outcomes, we use a combination of approaches. Because there is no comprehensive Major Field Achievement Test for Environmental Science, we have developed our own exit exams in core subject areas. We also give a pre- and post-written exam for general environmental science knowledge. Students take this exam at the beginning of ENVS 110, Environmental Science & Technology I and at the end of ENVS 492, Capstone. We perform exit interviews with graduating students and an alumni survey one year after graduation. Finally, we use Capstone projects in a several ways to assess various aspects of these outcomes.

First outcome—Our approach to the first outcome is to evaluate student performance on comprehensive exams and projects. First, we use the exit exams in core subject areas to assess this outcome. In the 2005 to 2006 assessment period, 13 students passed 45 of 52 exit exams on their first try. All except one student passed remaining exit exams on their second try. Although these results were good, we also decided to increase the passing grade from 70% to 75% on the second try of the exam. This modification encourages students to study for the exams rather than trying to pass an exam on the first try without studying and then retaking the exam.

In addition, faculty and outside project sponsors evaluate the Capstone projects with the following three criteria: A) Students understand the basic science underlying each of the environmental phenomena that are a part of this project; B) Students understand how the various aspects of environmental science involved in this project interact to form a system or whole; and C) Students have effectively applied the basic science to the real-world problem addressed in this project. In the 2005-06 assessment period, we determined that students need to do a better job at applying the knowledge they have gained from prior coursework to the solution of their Capstone project problems, and a better job of identifying and evaluating more than one option for solving their problem. For this reason, we now require students to include in their Capstone project work plans a thorough description of their project problem in terms of knowledge gained from prior coursework and an evaluation of two or more options for solving their problem.

Second outcome—Capstone projects are the basis for evaluating the second outcome, as well. Faculty and project sponsors evaluate project reports using these criteria: D) The project plan effectively addresses the project goals; E) The project plan is sufficiently complete, detailed, and organized to serve as a sound basis for the project work; F) The schedule, cost estimate, and quality assurance/quality control measures make sense for the project; G) The project plan was implemented with sufficient attention to detail and quality; and H) The project plan was fully implemented and completed (allowing for reasonable changes in scope). In the 2005-06 assessment period, we found that project plans did not always meet the project sponsor's goals. Thus, we now require each project team to meet with its sponsor to discuss its draft work plan. Plans are revised as necessary to better match the sponsor's needs.

We ask students to consider their own and their teammates' performances in the following areas: 1) Met with project team at agreed-upon times, and arrived on-time for these meetings; 2) Interacted with project team in a cooperative and constructive manner; 3) Initiated and completed assigned tasks in a timely manner; 4) Quality of work produced; and 5) Overall contribution to success of team. For the 2005-06 period, students in two of the four Capstone teams admitted that they did not initiate and complete tasks in a timely manner. The instructor will work more closely with students in the scheduling of tasks, and impose penalties for missing important intermediate milestones.

Third outcome—Our approach to the third outcome is to use a pre- and post-test developed by the Environmental Science faculty. The criteria for success are that each student will have a higher score on the exam as seniors and that each student will score at least 70% as seniors. For this evaluation period, we did not have enough data to evaluate if students are scoring higher on the exam as seniors since most of the graduating seniors had not taken the assessment exam as new students. For the second means of assessment, 10 of 13 senior scored greater than 70%, which is an improvement over the previous year (5 of 11). The mean and medians, respectively, for our senior students was 76% and 82%, while for our introductory students, they were 64% and 62%. This increase in 12% in mean score and 20% in median score over the introductory students indicates that students are retaining information on general ideas in environmental science. This is especially true given that a lot of that general information comes in our early courses which these seniors would have taken a few years prior to the exit exam.

Fourth outcome—Our approach to the fourth outcome is to use exit interviews with graduating seniors and alumni surveys one year after graduation. We surveyed 7 students who graduated in May 2006. The average response to questions about our program (courses available, material learned, equipment available, etc.) was 4.4 out of 5 (halfway between strong and very strong). A couple of students indicated that our facilities were only average, but did not provide any explanatory comments. A couple of students also indicated that the variety of courses available in the major was only average, but again said little about what else they would like to see. On the alumni survey, six of eight students who graduated in May 2005 returned the survey. Overall feedback was very positive, with indications that we were "strong" or "very strong" in most of the categories. Three students indicate that our performance was only "average" in "preparation for the real world." Some students suggested additional focus on technical writing. We do believe that we are providing an education that is about as real-world as it can possibly be in a college setting. However, to advance this effort further, we'll explore having some working professionals visit our classes, and having students prepare reports in selected courses in a format that better mimics the report types commonly used in the professional world. We will also explore options for more instruction on writing. Possibilities include more writing assignments in our courses (with greater scrutiny and feedback of writing), having students take the technical writing course offered in the English department, or bringing in someone to do a special course focused on writing Environmental Assessments. With that said, students in our program currently do quite a bit of writing and have a nice progression.

4. Faculty success

We mostly judge our faculty's success in terms of the success of our students, which is discussed in Section E.5, below. Other measures also indicate success. Each of the three faculty members routinely receives student evaluations ranging from 4 to 5 on a 5-point scale; most evaluations are at least 4.5. The faculty is active in campus affairs, serving on the Faculty Senate, Assessment Committee, Scholarship Committee, Athletic Council, Sustainability Council, and search committees. The faculty has also been active in off-campus affairs, serving on the Advisory Council for the McInnis Canyons National Conservation Area, Riverfront Commission, and a Grand Junction Environmental Education group. We have received grants and contracts for environmental projects from a number of organizations—Colorado National Monument, Bureau of Land Management, Bureau of Reclamation, Uravan Superfund Site Natural Resources Trust Fund, Colorado Division of Minerals and Geology, Colorado Energy Resources Institute, Garfield County. One member of the faculty has received a faculty Distinguished Service Award and an Outstanding Educator of the Year award from the Chamber of Commerce.

5. Student success

We believe the most appropriate measure of student success is the ability of our graduates to obtain positions in the environmental profession or gain admission to graduate school. Fiftyseven students graduated in the five-year period from 2002-03 through 2006-07. Forty-two are known to have landed positions in the environmental profession after graduation, nearly all with environmental services consulting firms. Three students went to graduate school (Colorado School of Mines, Colorado State University, and South Dakota State University). Seven have pursued other paths, at least for the time being ("time off", law enforcement, retail management, property management, divinity school, and motherhood). The fates of the remaining five students are unknown. We know of no graduate who has wanted environmental employment or graduate school admission who has been unable to attain it.

We have a good network of contacts among local employers. Several firms have hired five to ten of our graduates going back to the 1990's (e.g., Walsh Environmental, Cordilleran Compliance, Environmental Audit and Assessment), and some offices are dominated by our students. Current prospects for employment are excellent, due in part to the intensive development of natural gas resources in neighboring Garfield County. Over the past year or two, we have received about twice as many calls from employers looking for people to hire as we've had graduates to fill the positions

F. Program strengths

Breadth of curriculum—Our program provides students with diverse options. Students may pursue our concentration in Environmental Science to focus on the science and management of natural resources, or pursue the concentration in Environmental Restoration and Waste Management to focus on pollution control and cleanup. We also offer a concentration in Environmental Science Education for students seeking teacher licensure in middle and high school science.

Location—We are in an exceptional location for the study of environmental science in general and natural resources in particular. Within an hour's drive of campus, we can access semi-arid shrublands, pinyon-juniper woodlands, montane forests, subalpine forests, wetlands, and riparian areas. Our aquatic systems range from ephemeral headwater streams to the Colorado River. These areas include an enormous amount of public lands administered by the National Park Service, Bureau of Land Management, U.S. Forest Service, and Colorado Division of Parks and Recreation. We take good advantage of these diverse locations within our courses and applied research projects.

Field and project emphasis—Our coursework is field-oriented and students learn practical skills to supplement their lecture-based knowledge. We incorporate individual and group projects into many of our courses. In our Capstone course, students work in small groups to complete semester-long projects for off-campus clients. All three of our faculty members engage in applied research, usually sponsored by or in partnership with off-campus organizations, and we involve our students in these research projects. Our students gain considerable project-based and practical field experience that makes them highly employable.

Success of graduates—Our graduates are successful in starting careers in environmental science and gaining admission to graduate school. From the 2003 through 2007 academic years, ~80%

of our graduates are known to have obtained jobs as environmental professionals or enrolled in graduate school. We know of *no* graduates who have sought environmental employment but been unable to find it.

Faculty—We have a fully qualified, energetic faculty committed to undergraduate education. All three of our faculty members have a Ph.D. Two of our faculty members have held professional employment outside of academia. Two faculty members teach on-line classes, supporting Mesa State College's role as a regional education provider.

G. Program weaknesses

Enrollment—Although our enrollment is higher than that of every other science program at Mesa except for biology, we have unused capacity—we can accommodate and would like to have more EST majors. Given our program's strengths and the opportunities available to our graduates, it is unfortunate that so few students join our program.

Coherence of curriculum—Our curriculum has a somewhat piece-meal quality to it. As one would expect, our curriculum has evolved in response to turnover in our faculty and the experience gained in implementing the new program. We have also modified the curriculum in response to the needs of the environmental profession and the interests of our students. In some respects, our curriculum resembles a house to which several additions have been built at different times, introducing an unintentional degree of awkwardness into the cumulative effect. Our current curriculum may not be what we would have if we were to "start from scratch" at this time.

Workload due to project emphasis—We believe that faculty-directed applied research projects are a key element in the effort to maintain the program's vitality. Such projects generate excitement among the students and raise the program's visibility outside the department and the College. However, when coupled with the normal teaching load, which already includes lab and field contact hours that are not fully counted toward our workload, this project emphasis pushes us to the limits of our capabilities.

Workload due to course preps—An additional workload stress is the number of course preps we face in a typical semester. We rarely teach, as individuals, more than one section of the same course in the same semester. Only two courses in our curriculum are offered in both the fall and spring semesters, so we have a different slate of courses each semester. Several of our courses are offered only in alternate years, so our slate of courses varies with the year, as well. The cumulative effect of the need to do projects and teach a wide variety of courses is a feeling that we're often at or near a breaking point.

Lack of vitality in the Environmental Science Education program—Because of turnover in the program faculty, we no longer have a champion for the Environmental Science Education concentration. Only one student has completed this concentration, with another scheduled to graduate in December 2007. A few other students started in this concentration but decided to switch into one of the other concentrations. A concerted effort will be required to bring enrollment in Environmental Science Education up to a respectable level.

Availability of vans—Our frequent use of vans for transporting students to the field has some associated problems. Field work in Environmental Science is concentrated in the early fall in order to avoid snow, study aquatic systems at safe water levels, and study plants when they're not dormant. Biology and Geology similarly have field work to do in the early fall. The three programs thus compete with each other and other College users for three vans. On some occasions the outcome is too few vans to accommodate everyone's needs. Commercial rental vans are the backup, but availability is hit or miss. We must also note that if we achieve an increase in enrollment of about 50%, our van use will double.

H. Vision

Our vision is to be an enhanced version of what we already are—a great place for students to major in environmental science. We see an excellent faculty devoted to undergraduate education in all its forms, not just in-class learning but hands-on, project-based or research-based learning in the lab and field as well. We see a curriculum that is responsive to new developments and society's needs, such as the movement toward a more sustainable way of living We envision greater numbers of majors and graduates, who continue to be successful in professional work and graduate school.

1. Proposals for strengthening the programs

We have identified the following actions as important to improving the EST program.

Reconvene the EST advisory board, with membership updated to reflect current and anticipated future activity in environmental science—We maintained an advisory board from the inception of the precursor programs through the period in which we developed and received approval for the current EST program. However, we have not organized any meetings of the advisory board since our focus turned to implementation of the new program. A board with well-chosen membership would be an important asset.

Re-visit the EST curriculum—We can view this effort as having three parts. First, we should consider how we would create the program if we were starting from scratch. Are there key topics that are missing from our current program? Are there topics that should go away? Are topics taught at the right level (e.g., freshman, sophomore etc.)? Are there topics that should be given greater emphasis—perhaps their own course? Is there a better way to organize topics among courses and concentrations? Can we improve integration between courses? Are the non-Environmental Science courses required in our concentrations still appropriate as requirements? Second, we specifically need to examine the topic of sustainability and determine whether to add this to our curriculum. (With plans for courses in renewable energy in spring 2008 and sustainable building practices in spring 2009, we are already heading in this direction.)

Third, an essential part of the curriculum discussion is to revisit the viability of the concentration in Environmental Science Education. With input from the teacher education faculty and principals at middle and high schools in the College's service region, we should determine whether it makes sense to keep this concentration. If we keep it, we need a strategy for attracting more students.

After re-visiting the curriculum, we must identify any new faculty expertise needed and develop a strategy for obtaining it. Possibilities include a new tenure-track faculty member, development of new expertise within existing faculty, and/or use of part-time instructors.

Develop and implement a more aggressive strategy for bringing appropriate students into the program—We want to increase the number of EST graduates. Likely actions include creation of a recruiting video (underway), resurrecting and updating a brochure, and recruitment visits to high schools in the College's service region. We will also need to take care to retain qualified and promising students that are attracted to the program.

Clarify the natural resource career path—Many of the students who complete the concentration in Environmental Science, with its emphasis on natural resources management, accept jobs that are more in the realm of pollution-related work. We can work to identify more employment options that are a better match for students completing this concentration.

Mitigate workload issues—When feasible and appropriate, we may be able to make better use of local professionals on a part-time basis. We have made significant use of these people in the past, but with mixed results. With more attention to training of these instructors and oversight on our part, and a longer-term commitment on their part, we may be able to cultivate a higher quality performance and long-term solution for certain courses. Another possibility is to involve local professionals in our applied research projects. There are a number of highly qualified people in the community who are not working full-time that could be appropriate in this role.

Soils lab—The nature of the work that takes place in the soils lab precludes assigning that lab to our space in the Science Lab building. The soils lab is currently in an off-campus house, but that house will be torn down within the next two years or so. (This is the second off-campus location and third location overall for this lab. The previous off-campus lab was torn down last year.) We would like to have a longer term location. The Geology program has a similar need. Perhaps the most promising solution is to share an appropriate room in the anticipated addition to the Science Lab building.

Relationship with alumni—We rarely initiate contact with our alumni after they have been out of the program for more than one year. (Fortunately, it is not unusual for alumni to contact us looking for new graduates to hire.) A more active relationship with alumni may be beneficial. We can tap them for donations, their perspectives on the program, and more frequent contacts for new graduates. An annual newsletter could be a good vehicle for enhancing our relationship.

2. Priorities requiring additional resources

Our effort to revisit curriculum has the potential to require significant additional resources. A decision to revitalize the concentration in Environmental Science Education is likely to necessitate an additional faculty member. A concerted effort to include coursework in the scientific aspects of sustainability may also require another person.

Appendix A

Program Statistics for Past Five Years

Table 1. Environmental Science & Technology Degrees Awarded by Major Code, Academic Years 2002 - 2006

Level	Major Code	Program Name	Degree Attainment 2002	2003	2004	2005	2006
Baccalaureate							
	3440	Environmental Restoration & Waste Management	5	1	0	0	0
	3443	Environmental Science and Technology	0	2	0	0	0
	3444	Env Sci & Tech-Env Rest & Wast	2	3	2	4	0
	3445	Env Sci & Tech-Env Science	4	7	6	11	9
	3446	Env Sci & Tech-Ed Middle Chil	0	0	0	0	0
	3447	Env Sci & Tech-Ed Young Adult	0	0	0	1	0
TOTAL			**11**	**13**	**8**	**16**	**9**

Notes: 3440 Environmental Restoration & Waste Management, the BS program that preceded Environmental Science & Technology, was not fully phased out until 2003.

3443 is used as a temporary code for Environmental Science & Technology majors who have not yet selected a concentration. The two students who graduated under this code in 2003 actually completed the requirements for 3445 Environmental Science.

3446 Environmental Science Education Middle Childhood (elementary school) was pulled from our 1999 proposal but was retained in the College's tracking system.

Table 2. (Number of Majors, by Year

Environmental Science																											
Dege	EmphCd	Description	2002-2003					2003-2004					2004-2005					2005-2006					2006-2007				
			Majr1	Majr2	Majr3	Majr4	TOTAL	Majr1	Majr2	Majr3	Majr4	TOTAL	Majr1	Majr2	Majr3	Majr4	TOTAL	Majr1	Majr2	Majr3	Majr4	TOTAL	Majr1	Majr2	Majr3	Majr4	TOTAL
BS	3446	Env Sci & Tech-Ed Middle Chil	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BS	3447	Env Sci & Tech-Ed Young Adult	5	0	0	0	5	4	0	2	0	6	2	0	3	0	5	2	0	3	0	5	2	0	1	0	3
BS	3444	Env Sci & Tech-Env Rest & Wast	15	0	6	0	21	12	0	6	0	18	10	0	7	0	17	10	0	7	0	17	5	0	5	0	10
BS	3445	Env Sci & Tech-Env Science	49	1	3	0	53	59	1	10	0	70	56	0	10	0	66	57	0	10	0	67	45	0	14	0	59
BS	3440	Environ Rest & Waste Mgmt	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BS	3443	Environmental Science and Tech	12	0	0	0	12	4	0	0	0	4	1	0	0	0	1	1	0	0	0	1	1	0	0	0	1
Environmental Science Totals			83	1	9	0	93	79	1	18	0	98	69	0	20	0	89	70	0	20	0	90	53	0	20	0	73

Table 3C. Undergraduate Environmental Science Enrollment by Major Code, Spring Terms 2003 - 2007
Mesa State College

Level	Major Code	Program Name	2003	2004	2005	2006	2007
Baccalaureate							
	3440	Environ Rest & Waste Mgmt					
		New Majors	0	0	0	0	0
		Continuing Majors	1	0	0	0	0
	Sub-Total		**1**	**0**	**0**	**0**	**0**
	3443	Environmental Science and Tech					
		New Majors	3	0	0	0	0
		Continuing Majors	8	9	4	1	1
	Sub-Total		**11**	**9**	**4**	**1**	**1**
	3444	Env Sci & Tech-Env Rest & Wast					
		New Majors	1	2	3	2	0
		Continuing Majors	15	9	8	3	5
	Sub-Total		**16**	**11**	**11**	**5**	**5**
	3445	Env Sci & Tech-Env Science					
		New Majors	2	1	6	8	4
		Continuing Majors	34	40	43	42	30
	Sub-Total		**36**	**41**	**49**	**50**	**34**
	3446	Env Sci & Tech-Ed Middle Chil					
		New Majors	0	0	0	0	0
		Continuing Majors	1	1	0	0	0
	Sub-Total		**1**	**1**	**0**	**0**	**0**
	3447	Env Sci & Tech-Ed Young Adult					
		New Majors	0	1	1	0	0
		Continuing Majors	3	4	3	2	2
	Sub-Total		**3**	**5**	**4**	**2**	**2**
	All Environmental Science						
		New Majors	**6**	**4**	**10**	**10**	**4**
		Continuing Majors	**62**	**63**	**58**	**48**	**38**
Grand Total			**68**	**67**	**68**	**58**	**42**

Table 4. HEADCOUNT AND CREDIT HOUR DISTRIBUTION BY COURSE LEVEL BY TERM AY 2007

Level/Course Level	Summer Headcount		Summer Credit Hours		Fall Headcount		Fall Credit Hours	
Undergraduate								
Remedial - 000	0	0.0%	0.0	0.0%	0	0.0%	0	0.0%
Lower - 100	0	0.0%	0.0	0.0%	73	34.0%	195	40.2%
Lower - 200	0	0.0%	0.0	0.0%	6	2.8%	6	1.2%
Upper - 300	0	0.0%	0.0	0.0%	131	60.9%	271	55.9%
Upper - 400	5	100.0%	20.0	100.0%	5	2.3%	13	2.7%
Subtotal Undergraduates	**5**	**100.0%**	**20.0**	**100.0%**	**215**	**100.0%**	**485**	**100.0%**
Graduate								
Graduate - 500	0	0.0%	0.0	0.0%	0	0.0%	0	0.0%
Subtotal Graduates	**0**	**0.0%**	**0.0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
Total	5	100.0%	20.0	100.0%	215	100.0%	485	100.0%

Level/Course Level	Spring Headcount		Spring Credit Hours		Total Credit Hours	
Undergraduate						
Remedial - 000	0	0.0%	0.0	0.0%	0	0.0%
Lower - 100	57	40.7%	171.0	45.6%	366	41.6%
Lower - 200	2	1.4%	6.0	1.6%	12	1.4%
Upper - 300	41	29.3%	97.0	25.9%	368	41.8%
Upper - 400	40	28.6%	101.0	26.9%	134	15.2%
Subtotal Undergraduates	**140**	**100.0%**	**375.0**	**100.0%**	**880**	**100.0%**
Graduate						
Graduate - 500	0	0.0%	0.0	0.0%	0	0.0%
Subtotal Graduates	**0**	**0.0%**	**0.0**	**0.0%**	**0**	**0.0%**
Total	140	100.0%	375.0	100.0%	880	100.0%

Table 5. **HEADCOUNT AND FULL-TIME EQUIVALENT ENVIRONMENTAL SCIENCE ENROLLMENTS AY 2007**

Level/Tuition Classification	Headcount		Credit Hours		FTE	
Undergraduate						
In-State	294	81.7%	729	82.8%	24.3	82.8%
Out-of State	66	18.3%	151	17.2%	5.0	17.2%
Subtotal	**360**	**100.0%**	**880**	**100.0%**	**29.3**	**100.0%**
Graduate						
In-State	0	-	0	-	0.0	-
Out-of State	0	-	0	-	0.0	-
Subtotal	**0**	**0.0%**	**0**	**0.0%**	**0.0**	**0.0%**

Table 6. One-Year Retention Rate for First-Time Environmental Science & Technology Majors 2001-2005 Fall Semesters

Level	Major Code	Program Name	Retained or Graduated Subsequent Fall #	Retained or Graduated Subsequent Fall %	Not Retained Subsequent Fall #	Not Retained Subsequent Fall %	Total #	Total %
Baccalaureate								
	3440	Environ Rest & Waste Mgmt	-	-	-	-	-	-
	3443	Environmental Science and Tech	5	71.4%	2	28.6%	7	100.0%
	3444	Env Sci & Tech-Env Rest & Wast	3	60.0%	2	40.0%	5	100.0%
	3445	Env Sci & Tech-Env Science	11	50.0%	11	50.0%	22	100.0%
	3446	Env Sci & Tech-Ed Middle Chil	-	-	-	-	-	-
	3447	Env Sci & Tech-Ed Young Adult	1	100.0%	0	0.0%	1	100.0%
TOTAL			**20**	**57.1%**	**15**	**42.9%**	**35**	**100.0%**

Table 7. Headcount and Average Cumulative Credit Hours to Degree for Environmental Science & Technology Majors Graduating in Academic Years 2002 - 2006

Type of Entry into MSC	Headcount		Average
Student Type			
Began at MSC	37	57.8%	142.0
Transferred in to MSC	27	42.2%	158.4
Total **Subtotal**	**64**	**100.0%**	**148.9**

Table 8. Courses by Level by Term in Academic Year 2007

Level/Course Level	Summer Courses		Fall Courses		Spring Courses		Total Courses	
Undergraduate								
Remedial - 000	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Lower - 100	0	0.0%	5	20.8%	4	22.2%	9	20.9%
Lower - 200	0	0.0%	2	8.3%	1	5.6%	3	7.0%
Upper - 300	0	0.0%	13	54.2%	6	33.3%	19	44.2%
Upper - 400	1	100.0%	4	16.7%	7	38.9%	12	27.9%
Subtotal Undergraduates	**1**	**100.0%**	**24**	**100.0%**	**18**	**100.0%**	**43**	**100.0%**
Graduate								
Graduate - 500	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Subtotal Graduates	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
Total	1	100.0%	24	100.0%	18	100.0%	43	100.0%

Table 9. Environmental Science & Technology Faculty by Tenure Status
Academic Years 2005-2007

	Env Sci & Tech	2005 FTE		2006 FTE		2007 FTE	
		FTE	%	FTE	%	FTE	%
Status							
	Tenure	2.0	52.6%	1.0	27.8%	2.0	54.1%
	Tenure-Track	1.0	26.3%	2.0	55.6%	1.0	27.0%
Total Tenure		**3.0**	**78.9%**	**3.0**	**83.3%**	**3.0**	**81.1%**
	FT Instructor	0.0	0.0%	0.0	0.0%	0.0	0.0%
	PT Instructor	0.8	21.1%	0.6	16.7%	0.7	18.9%
TOTAL		**3.8**	**100.0%**	**3.6**	**100.0%**	**3.7**	**100.0%**

Appendix B

Finance and Budget

MESA STATE COLLEGE
FY04 Cost Analysis

Dept/Subj		BANNER	CH Total F03 S04	Faculty Comp	Class Comp	Dept Head Comp	Admin Comp	Academic Support	Stud Srvs Alloc	Instit Supp Alloc	Plant Alloc	OCE	TOTAL COSTS	TOTAL COSTS/CH
ENVIRON REST														
ENVS	LOWER	1450	558.0	84,256		112	-	13,513	10,462	9,560	12,928	10,064	140,896	253
	UPPER		490.0	85,198		99	-	11,866	9,187	8,395	11,353	8,838	134,935	275
		1450 Total	1,048.0	169,454		211		25,379	19,649	17,954	24,281	18,902	275,831	263

Appendix C

Library Assessment

information source for this field. The Library is a "Select" federal repository for documents published by the U.S. government and its agencies.

c. Periodicals

The Library has 38 print periodicals on various aspects of environmental science, 14 are open subscriptions and 24 are closed. There are also titles in the related areas of biology and chemistry. Access to online periodical titles is substantial, e.g., 30 titles are available under the subject "environmental science" and 34 on "pollution".

d. Electronic Resources

The Library's current online database subscriptions provide excellent coverage for this program. GeoRef, the top database in the earth sciences field is available, as well as GEOBASE. Full-text resources include Science Direct and OmniFile Select. The general subject database Academic Search Premier contains ample current and comprehensive information on the main subject areas of this program. There is also substantial biology coverage in Biological Sciences and BioOne, chemistry coverage in ACS Publications, and comprehensive news and legal material available in Lexis-Nexis. All of these resources are available to students 24/7 from any Internet computer.

2. Evaluation of the total collection

a. Strengths

The Library currently has good or better resources in all subjects relevant to this degree program. It is especially strong in the online databases area and in the high number of circulating books available to students. The print collection is also newer than many other academic programs at the College.

b. Weaknesses

No significant weaknesses.

3. Recommendations

No additional funds are required for Library support of the Environmental Science program. Continual updating of the print collection with new titles can be achieved through current budget allocations with faculty and student input.

Library Director: ______Elizabeth W. Brodak______ Date: ____8/10/07____

Appendix D

Most Recent Program Review Summary

The present review is the first review conducted for the Bachelor of Science in Environmental Science and Technology. Because the proposal for the current degree was being evaluated at the time that the original four-year degree was scheduled for review, the Office of State Colleges waived the review of the original four-year program.

Appendix E

Assessment Plan and Results

Degree Program: **B.S. in Environmental Science and Technology**

Assessment Period Covered: August-05 to May-06
Date Submitted: October 20, 2006

Expanded Statement of Institutional Purpose Linkage:

Institutional Mission Reference:
Mesa State College shall offer liberal arts and sciences programs.

College/University Goal(s) Supported:
The College develops the intellectual, ethical, and aesthetic sensibilities that enable a student to pursue a rewarding career and assume a responsible and productive role in society.

The College seeks to … help them observe reality precisely, to judge opinions and events critically, to think logically, and to communicate effectively.

Intended Education (Student) Outcomes:

1. Students show a strong foundation in understanding the behavior and interactions of physical, chemical, and biological components of the environment.

2. Students demonstrate the ability to plan, implement and communicate the results of an environmental project.

3. Students demonstrate knowledge of historical and current approaches to environmental problems and controversies.

4. Students are prepared for a job or advanced study in the environmental field.

Degree Program: **B.S. in Environmental Science and Technology**

Assessment Period Covered: August-05 to May-06
Date Submitted: October 20, 2006

Intended Educational (Student) Outcome:

1. Students show a strong foundation in understanding the behavior and interactions of physical, chemical, and biological components of the environment.

First Means of Assessment for Outcome Identified Above:

Means of Program Assessment and Criteria for Success:
Exit exams (developed internally) in core subject areas. The criterion for success is for 100% of the students to score at least 70%. Environmental Science faculty will discuss the exit exam results and determine if any programmatic changes are warranted.

Summary of Assessment Data Collected:
13 students passed 45 of 52 exit exams on their first try. All except one student passed remaining exams on their second try. (That one student has one exam left to take.)

Use of Results to Improve Instructional Program
These are good results that do not suggest any changes.

Second Means of Assessment for Outcome Identified Above:

Means of Program Assessment and Criteria for Success:
Student Capstone projects will be evaluated by all MSC Environmental Science faculty and off-campus project sponsors for evidence of meeting this outcome using criteria A, B, and C on the Evaluation of Capstone Projects (attached).

Summary of Assessment Data Collected:
We would like to see students do a better job at applying the knowledge they have gained from prior coursework to the solution of their Capstone project problems, and a better job of identifying and evaluating more than one option for solving their problem.

Use of Results to Improve Instructional Program
We will require students to include in their Capstone project work plans a section where they thoroughly describe and define their project problem in terms of knowledge gained from prior coursework. They will also be required to identify and evaluate two or more options for solving their problem, and to include this evaluation in their Capstone project report.

Degree Program: **B.S. in Environmental Science and Technology**

Assessment Period Covered: August-05 to May-06
Date Submitted: October 20, 2006

Intended Educational (Student) Outcome:

2. Students demonstrate the ability to plan, implement and communicate the results of an environmental project.

First Means of Assessment for Outcome Identified Above:

Means of Program Assessment and Criteria for Success:
Student Capstone projects will be evaluated by MSC Environmental Science faculty and outside project sponsors for evidence of this outcome using criteria D through H on the rubric Evaluation of Capstone Projects (attached), and the rubric Evaluation of Capstone Presentations (attached).

Summary of Assessment Data Collected:
Project plans didn't always meet the project sponsor's goals.

Use of Results to Improve Instructional Program
We will require each project team to meet with its sponsor to discuss its draft work plan. Plans will be revised as needed to better match the sponsor's needs.

Second Means of Assessment for Outcome Identified Above:

Means of Program Assessment and Criteria for Success:
Peer evaluation of student Capstone projects using the rubrics Evaluation of Capstone Projects and Evaluation of Capstone Presentations (attached). Environmental Science faculty will consider the results of these evaluations and determine any changes that might be needed to improve student capabilities in weak areas.

Summary of Assessment Data Collected:
Student evaluations tended to echo the observation of faculty and sponsors that some teams did not demonstrate an in-depth understanding of their problem, and were weak in their interpretation of their findings.

Use of Results to Improve Instructional Program
We will require students to include in their Capstone project work plans a section where they thoroughly describe and define their project problem in terms of knowledge gained from prior coursework. They will also be required to identify and evaluate two or more options for solving their problem, and to include this evaluation in their Capstone project report.

Third Means of Assessment for Outcome Identified Above:

Means of Program Assessment and Criteria for Success: Self-evaluation and team-mate peer evaluation of individual student performance on Capstone projects using the rubric Self-Evaluation and Peer Assessment (attached). Environmental Science faculty will consider the results of these evaluations and determine any changes that might be needed to improve student capabilities in weak areas.

Summary of Assessment Data Collected: Students in two of the four Capstone teams admitted (and rightfully so) that they did not initiate and complete tasks in a timely manner.

Use of Results to Improve Instructional Program We may be able to improve this by having the instructor work more closely with the students in their scheduling of tasks, and imposing penalties for missing important intermediate milestones.

Degree Program: B.S. in Environmental Science and Technology

Assessment Period Covered: August-05 to May-06
Date Submitted: October 20, 2006

Intended Educational (Student) Outcome:

3. Students demonstrate knowledge of historical and current approaches to environmental problems and controversies.

First Means of Assessment for Outcome Identified Above:

Means of Program Assessment and Criteria for Success:
A written exam developed by the Environmental Science faculty will be given to students at the beginning of ENVS 110 Environmental Science & Technology I and at the end of ENVS 492 Capstone. Pre- and post-performance will be tracked for each student. The criterion for success is 1) for each student to achieve a higher score when they take the exam as seniors, and 2) for each student to score at least 70% when they take the exam as seniors.

Summary of Assessment Data Collected:
1) This is only the third year of implementation of this means of assessment, so we are not yet able to evaluate the first criterion. 2) 10 of 13 seniors scored greater than 70%, which is an improvement over last year (5 of 11). The mean and medians, respectively, for our senior students was 76% and 82% while for our introductory students, it was 64% and 62%. This increase of 12% in mean score and 20% in median score indicates students probably are retaining information on general ideas in environmental science. This is especially true given that a lot of that general information comes in our early courses which these seniors would have taken a couple of years prior to the exit exam.

Use of Results to Improve Instructional Program
The results of this means of assessment do not suggest any improvements.

Degree Program: B.S. in Environmental Science and Technology

Assessment Period Covered: August-05 to May-06
Date Submitted: October 20, 2006

Intended Educational (Student) Outcome:

4. Students are prepared for a job or advanced study in the environmental field.

First Means of Assessment for Outcome Identified Above:

Means of Program Assessment and Criteria for Success:
Evidence of this outcome will be evaluated through exit interviews with graduating students using the attached form.

Summary of Assessment Data Collected:
We have surveys from the 7 students who graduated in May 2006. The average response was 4.4 out of 5 (about halfway between "strong" and "very strong"). A couple students indicated that our facilities were only average, but didn't provide any explanatory comments. A couple students also indicated that the variety of courses available in the major was only average, but said little about what else they would like to see.

Use of Results to Improve Instructional Program
We're pleased with the overall result, and don't believe there is a need at this time for any changes based on these data.

Second Means of Assessment for Outcome Identified Above:

Means of Program Assessment and Criteria for Success:
Evidence of this outcome will be evaluated by way of an alumni survey conducted one year after each student's graduation (attached).

Summary of Assessment Data Collected:
Six of eight students who graduated in May 2005 returned surveys. Overall the feedback was very positive, with indications that we were "strong" or "very strong" in most of the categories. Three students indicated that our performance was only average in "preparation for the real world". Some students suggested additional focus on technical writing.

Use of Results to Improve Instructional Program
We believe we're providing an education that is about as real-world oriented as it can possibly be in a college setting. But in an effort to enhance this further, we'll explore 1) having some working professionals visit our classes, and 2) having students prepare reports (in selected classes) in a format that better mimics the report types commonly used in the professional world. We will also explore options for more instruction on writing. Possibilities include more writing assignments in our courses (with greater scrutiny and feedback of writing), having students take the technical writing course offered in the English department, or bringing in someone to do a special course focused on writing environmental assessments.

Capstone (ENVS 492)—Evaluation of Capstone Projects

2005

Project title:

Reviewer: (circle one)
Student
MSC ES faculty
Project sponsor
Other outside reviewer

Ratings:

5 = Very Strong   4 = Strong   3 = Average   2 = Weak   1 = Very Weak

5 4 3 2 1   A. The students understand the basic science underlying each of the environmental phenomena that are a part of this project.

5 4 3 2 1   B. The students understand how the various aspects of environmental science involved in this project interact to form a system or whole.

5 4 3 2 1   C. The students have effectively applied the basic science to the real-world problem addressed in this project.

5 4 3 2 1   D. The project plan effectively addresses the project goals.

5 4 3 2 1   E. The project plan is sufficiently complete, detailed, and organized to serve as a sound basis for the project work.

5 4 3 2 1   F. The schedule, cost estimate, and quality assurance/quality control measures make sense for the project.

5 4 3 2 1   G. The project plan was implemented with sufficient attention to detail and quality.

5 4 3 2 1   H. The project plan was fully implemented and completed. (Allow for reasonable changes in scope.)

Comments:

Capstone (ENGS 492)—Evaluation of Presentations 2006

Project title:

Reviewer: (circle one)
Student
MSC ES faculty
Project sponsor
Other outside reviewer

Ratings:

5 = Very Strong 4 = Strong 3 = Average 2 = Weak 1 = Very Weak

1. Organization of presentation: Were topics presented in a logical sequence?

2. Quality of visual aids: Did the overheads, slides, or PowerPoint display provide effective support for the speakers? Were the visual aids neat and well-organized?

3. Completeness: Were project goals and objectives stated? Was each goal and objective covered later in the presentation? Was there a finding or recommendation for each goal and objective? Did the content of the presentation support the recommendations?

4. Quality of oral presentation: Did the presenter speak clearly? Were you able to hear the speaker? Was the content of the speaker's presentation well-organized? Did the speaker's delivery reflect thoughtful preparation and practice?

   Speaker 1

   Speaker 2

   Speaker 3

   Speaker 4

5. Quality of the project: What score would you give for the overall quality of the work done by this group on their project? (That is, how would you score the quality of the *content* of the presentation, as opposed to the presentation itself?)

Capstone (ENGS 492) 2006
Self-Evaluation and Peer Evaluation

Consider your performance and the performance of each of your teammates in the following areas:

1. Met with project team at agreed-upon times, and arrived on-time for these meetings. (This includes our regularly scheduled class meeting times.)
2. Interacted with project team in a cooperative and constructive manner.
3. Initiated and completed assigned tasks in a timely manner.
4. Quality of work produced
5. Overall contribution to success of team

In the blanks shown below, fill in a score from 1 to 5 for you and each teammate for each of the five areas defined above.

5 = Very Strong 4 = Strong 3 = Average 2 = Weak 1 = Very Weak

Area	Yourself	Teammate	Teammate	Teammate
1				
2				
3				
4				
5				

Appendix F

Faculty Vitae

CURRICULUM VITAE
Deborah K. Kennard
Mesa State College, 1100 North Ave. Grand Junction, CO 81503
(970) 248-1895; dkennard@mesastate.edu

Education

- Ph.D., Botany, 2000, University of Florida, Gainesville, Florida.
- M.S., Botany, 1996, University of Florida, Gainesville, Florida.
- B.A., Biology, 1991, Trinity University, San Antonio, Texas.

Selected work experience

- Assistant Professor, Department of Physical and Environmental Sciences, Mesa State College, Grand Junction, CO, 2005-present.
- Research Ecologist, U.S.D.A. Forest Service, SRS-4104, Auburn, AL, 2001- 2005.
- Research Ecologist, U.S.D.A. Forest Service, SRS-4101, Athens, GA, 2000-2001.
- Research Fellow, Proyecto de Manejo Forestal de Sostenible (BOLFOR), Santa Cruz, Bolivia, 1997-1999.
- Lab instructor, University of Florida, 1994-1997, 1999
- Field Technician, Danum Valley Field Center, Sabah, Malaysia 1993.
- English Teacher, Saitama Prefecture, Japan 1992.

Selected Publications

- Kennard, D.K. and K.W. Outcalt. 2006. Modeling spatial patterns of fuels and fire behavior in a longleaf pine forest in the southeastern USA. Fire Ecology 2(1): 31-52.
- Kennard, D. K., Outcalt, K.W., Jones, D., O'Brien, J.J. 2005. Comparing techniques for estimating flame temperature of prescribed fires. Fire Ecology 1: 70-84.
- McDaniel, J., Kennard, D, and Fuentes, A. 2005. Smokey the Tapir: Traditional Fire Knowledge and Fire Prevention Campaigns in Lowland Bolivia. Society and Natural Resources 18:1-11.
- Kennard, D.K. and F.E. Putz. 2005. Differential responses of Bolivian timber species to prescribed fire and other gap treatments. New Forests 30: 1-20
- Kennard, D.K. Rauscher, H.M., Flebbe, P.A. Schmoldt, D.L., Hubbard, W.G., Jordin, J.B., Milnor, W. 2005. Using hyperdocuments to manage scientific knowledge: the prototype Encyclopedia of Southern Appalachian Forest Ecosystems. Forest Ecology and Management 207: 201-213.
- Kennard, D. K. 2004. Commerical tree regeneration 6 years after high-intensity burns in a seasonally dry forest in Bolivia. Canadian Journal of Forest Research 34: 1-9.
- Kennard, D.K. 2002. Secondary forest succession in a dry tropical forest: patterns of development across a 50-year chronosequence in lowland Bolivia. Journal of Tropical Ecology 18: 55-66.
- Kennard, D.K., K. Gould, F.E. Putz, T.S. Fredericksen, F. Morales. 2002. Effects of disturbance intensity on regeneration mechanisms in a tropical dry forest. Forest Ecology and Management 162:197-208.
- K.A. Gould, T.S. Fredericksen, F. Morales, D. Kennard, F.E. Putz, B. Mostacedo, M. Toledo. 2002. Post-fire tree regeneration in lowland Bolivia: implications for fire management. Forest Ecology and Management 165: 225-234.
- Kennard, D.K., and H. L. Gholz. 2001. Effects of high and low intensity fire on soil properties and plant growth in a Bolivian dry forest. Plant and Soil 234: 119-129.
- Fredericksen, T.S., M.J. Justiniano, B. Mostacedo, D.K. Kennard, L. McDonald. 2000. Comparative regeneration ecology of three leguminous timber species in a Bolivian tropical dry forest. New Forests 20:45-64.
- Chapman, C.A., R.W. Wrangham, L.J. Chapman, D.K. Kennard, and A.E. Zanne. 1999. Fruit and flower phenology at two sites in Kibale National Park, Uganda. Journal of Tropical Ecology 15: 189-211.
- Stern, M.J., K. Goodell, and D.K. Kennard, 1999. Local distribution of *Chusquea tomentosa* (Poaceae:

Bambusoideae) before and after a flowering event. Biotropica 31(2): 78-82
- Kennard, D.K. 1998. Biomechanical properties of tree saplings and free-standing lianas as indicators of susceptibility to logging damage. Forest Ecology and Management 102: 179-191.

Non-refereed publications

- Kennard, D.K. *Encyclopedia of Southern Fire Science* (http://fire.forestencyclopedia.net). Editor and author 2002-2005.
- Kennard, D.K. *Encyclopedia of Southern Appalachian Forest Ecosystems* (http://www.forestencyclopedia.net). Editor and author 2000-2002.
- Kennard, D.K., Outcalt, K.W., Jones, D., Estes, B. 2003. Techniques and sampling strategies for comparing fires of different intensities. Proceedings of the Second International Wildland Fire Ecology and Fire Management Congress. American Meteorological Society. November 16-20, 2003, Orlando, Florida.
- Outcalt, K.W. and D.K. Kennard. 2003. Developing management options for fuel reduction in pine flatwoods of the southeast. Proceedings of the Second International Wildland Fire Ecology and Fire Management Congress. American Meteorological Society. November 16-20, 2003, Orlando, Florida.
- Kennard, D. K., Outcalt, K.W., Lockaby, G., and Governo, R. 2003. Spatial patterns of fuel loads, fire intensity, and microbial biomass in a longleaf pine forest. In: Uplands to Lowlands: Coastal Processes in a Time of Global Change. The Ecological Society of America 88th Annual Meeting. August 3-8, 2003, Savannah, Georgia.
- Kennard, D.K., Rauscher, H.M., Flebbe, P.A., Schmoldt, D.L., Hubbard, W.G., Jordin, B., Milnor, W. H. 2003. The Encyclopedia of Southern Appalachian Forest Ecosystems: A Prototype of an Online Scientific Knowledge Management System. IN: Vacik, H., Lexer, M.J., Rauscher, H. M., Reynolds, K. M., Brooks, R. T. (eds.). 2003. Decision support for multiple purpose forestry. CD-Proceedings of a IUFRO Conference at the University of Natural Resources and Applied Life Science, April 23-25, 2003, Vienna, Austria.
- Kennard, D.K., K. Outcalt, and M. Carrington. 2002. *Serenoa repens* (Bartr.) Small saw palmetto. In: J.K. Francis (ed.) Wildland shrubs of the United States and its territories. Gen. Tech. Rep. IITF-WB-1. http://www.fs.fed.us/global/iitf/wildland_shrubs.htm. 3 p.
- Stanturf, J.A., Wade, D.W., Waldrop, T., Kennard, D.K., and Achtemeier, G. 2002. Fire in southern forest lanscapes. Pp. 607-630 *In:* Wear, D.M. and Greis, J. (Eds.) Southern Forest Resource Assessment. General Technical Report SRS-53. U.S.DA. Forest Service, Southern Research Station, Asheville, NC.
- Kennard, D.K., T.S. Fredericksen, B. Mostacedo. 2001. The potential of prescribed fire for the management of timber species in dry forests: A case study from Lomerio. *In:* Regeneracion y Silvicultura de Bosques Tropicales en Bolivia. B. Mostacedo and T.S. Fredericksen (Eds.) Proyecto de Manejo Forestal de Sostenible (BOLFOR), Santa Cruz, Bolivia.
- Fredericksen, T.S., and D.K. Kennard. 1999. Guia Para la Realizacion de Quemas Controladas (Guide to Conducting Controlled Burns). Proyecto de Manejo Forestal de Sostenible (BOLFOR), Santa Cruz, Bolivia.
- Kennard, D.K. 1995. Capparaceae. *In*: Tree Flora of Sabah and Sarawak. Volume I. E. Soepadmo and K.M. Wong, (Eds.) Ampang Press Sdn. Bhd., Kuala Lumpur.

Selected grants received

- **Joint Fire Science Program**, 2004. Awarded $497,763 for grant proposal: *An Internet-based portal for fire science and management in the southern region.* Co-PI.
- **Joint Fire Science Program**, 2004. Awarded $127,992 for grant proposal: *Best Management Practices for Fuels Management in Sub-tropical Pine Flatwoods and Tropical Pine Rocklands.* Co-PI.
- **National Fire Plan**, 2002, 2003, 2004. Awarded $795,000 for grant proposal: *An Internet-Based Encyclopedia of Southern Fire Science and Management Knowledge: Ready Access to the Right Information in the Right Form.* Lead PI.
- **BOLFOR**, 1997-8. Awarded $20,000 for grant proposal: *Effects of fire of varying intensity on Bolivian dry forests.* Lead PI

CURRICULUM VITAE

Tamera J. Minnick, Ph.D.
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Mesa State College
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Academic Training:

Degree	Year	Institution	Major	Minors
B.S. with honors	1989	University of Nebraska - Lincoln	Biology	Math, Physics, Anthro
Ph.D.	1998	Colorado State University	Ecology	

Dissertation: Abiotic Factors Affecting Distribution and Dominance Patterns of Two C_4 Perennial Grass Species

Professional Experience:

2005-present	**Associate Professor**, *Mesa State College*, Grand Junction, Colorado
2002-2005	**Assistant Professor**, *Mesa State College*, Grand Junction, Colorado
2000-2002	**Assistant Professor,** *Nebraska Wesleyan University,* Lincoln, Nebraska
1999-2000	**Visiting Assistant Professor**, *Nebraska Wesleyan University*, Lincoln, Nebraska.
1998-1999	**Post-doctoral Research Associate**, *University of Nebraska*, Lincoln, Nebraska.
1997-1998	**Plant Physiologist**, *U.S. Forest Service*, Rocky Mountain Forest and Range Research Station, Ft. Collins, Colorado
1993-1998	**National Science Foundation Pre-Doctoral Fellow** and Graduate Research Assistant, Graduate Degree Program in Ecology, *Colorado State University*, Ft. Collins, Colorado
1993	**Microbiologist**, *BioNebraska*, Lincoln, Nebraska
1992	**Science and Stewardship Outreach Program Director**, *The Nature Conservancy*, Niobrara Valley Preserve, Johnstown, Nebraska
1989-1991	**Secondary Science Teacher**, *U.S. Peace Corps* and Ministry of Education, Nairagie Engare, Kenya

Honors and Awards:

Uravan Natural Resources Damage Fund Revegetation and Mine Closure at Abandoned Uranium Mine Sites	$30,000	2005-present
National Park Service Cooperative Grant Native Plant Restoration of a CCC Camp at the Colorado National Monument	$11,085	2004-present
BLM Challenge Cost Share Grant Non-native Plant Site Revegetation	$10,000	2004-present
Colorado River Salinity Forum Grants (Co-PI with USGS) Documenting the Effects of Grazing on Sediment, Water, and Salinity Production from Mancos Shale Soils	$170,000	2003 – present
National Science Foundation Pre-doctoral Fellow	$69,000	1994-1997
CSU Student Ecology Symposium presentation award		1996
Student award to attend spatio-temporal dynamics conference at NCEAS		1996
LTER Graduate Student Cross-Site Research Competition	$1500	1995
Colorado State Special Fellow	$12,456	1993-1994

Phi Beta Kappa, awarded 1989

National Merit Scholar	\$3000	1985-1989
University of Nebraska Regents' Scholar	\$6000	1985-1989

University, Professional and Community Service:

- 2007 Mentored early career science women with MentorNet
- 2007 Advised Capstone Project on tamarisk removal and restoration (4 students)
- 2006 Structured research on Uravan mine reclamation project (1 student)
- 2006 Appointed Bureau of Land Management's Advisory Committee for McInnis Canyons National Conservation Area
- 2006 Science Fair Judge
- 2005 Structured research on COLM restoration project, BLM restoration project, and Uravan project (15 students)
- 2004 Structured research on two COLM restoration projects (2 students)
- 2004 Science Fair Committee Member
- 2004 Outside Review Committee Member for Math Program Review
- 2004-2007 Co-organizer with Gigi Richard of the Seminar series on Natural Resources: Land and Water
- 2004 Supervisor of student employee on USGS Badger Wash Project
- 2002-present Faculty Representative for Udall Scholarship
- 2003 Tiarra Creek Purple Loosestrife Project with County Weed Manager Jude Sirota, Russ Walker and two students
- 2002 Reviewer for Ecological Applications manuscript

Papers and Posters Presented:

1. Minnick, T.J., R.D. Alward, J.S. Christiansen, K.F. Lambert, and K.H. Burden. 2007. Resource enhancement techniques as an aid to shrub transplant success in shrubland restoration. Ecological Society of America and Society for Ecological Restoration meeting. August 2007.
2. Alward, R.D., A. Clements, H. Metz, and T.J. Minnick. 2005. Evaluating the efficacy of fuels reduction treatments: developing management tools for promoting biodiversity and controlling cheatgrass in west-central Colorado. Ecology and Management of Pinyon-Juniper and Sagebrush Communities, Montrose, Colorado.
3. Minnick, T.J. 2004. Documenting the effects of grazing on sediment, water, and salinity production from Mancos shale soils: Reigniting the Badger Wash long-term experiment. Mesa State College Faculty Colloquium, Grand Junction, Colorado.
4. Minnick, T.J., L.K Piller, and R.L Flegel. 2002. Changes in ecosystem properties with landscape position in a Nebraska Sandhills prairie. 17th Annual Symposium, International Association of Landscape Ecology, Lincoln, Nebraska.
5. Flegel, R.L., and T.J. Minnick. 2002. The effect of mowing and grazing on soil water, nitrogen and biomass in Arapaho Prairie, a Nebraska Sandhills Prairie. Nebraska Academy of Sciences Annual Meeting, Lincoln, Nebraska.
6. Minnick, T.J. 2000. Abiotic factors affecting distribution and dominance patterns of two C_4 perennial grass species. Furman University, Greenville, South Carolina.
7. Wedin, D.A., M. Bullerman, and T.J. Minnick. 2000. Carbon balance of long-term experimental pine forests in the Nebraska Sandhills: A tradeoff between net carbon storage and soil carbon losses. Bull. Ecol. Soc. Am. (Suppl.) 81:354.
8. Minnick, T.J. 1999. Abiotic factors affecting distribution and dominance patterns of two C4 perennial grass species. TriBeta Meeting, Nebraska Wesleyan University.
9. Minnick, T.J. 1999. Invasiveness of plant species and invasability of ecosystems. Washington and Jefferson College, Washington, Pennsylvania.
10. Minnick, T.J., and D.A. Wedin. 1999. Consequences on ecosystem function of vegetation change along a grassland to forest continuum. Bull. Ecol. Soc. Am. (Suppl.) 79: 42.
11. Alward, R.D., T.J. Minnick, and J.K. Detling. 1999. Warmer nights versus warmer days: Different responses in the plains prickly pear cactus. Bull. Ecol. Soc. Am. (Suppl.) 79:151.
12. Minnick, T. J., and D. P. Coffin. 1997. Effect of soil texture on regional patterns of grass seedling establishment predicted from a soil water model. Bull. Ecol. Soc. Am. (Suppl.) 78: 149.

13. Minnick, T.J., and D. P. Coffin. 1996. Common garden study of *Bouteloua gracilis* and *Bouteloua eriopoda* in northern Colorado. Bull. Ecol. Soc. Am. (Suppl.) 77: 308.
14. Minnick, T.J., and D. P. Coffin. 1996. Cross-site comparisons of two North American C_4 perennial grasses: *Bouteloua gracilis* and *Bouteloua eriopoda*. 2nd Annual Ecological Research at CSU Student Symposium, Ft. Collins. CO.
15. Minnick, T. J., and D. P. Coffin. 1995. Predicting recruitment of *Bouteloua gracilis* and *Bouteloua eriopoda* across an environmental gradient using a soil water simulation model. Bull. Ecol. Soc. Am. (Suppl.) 76: 186.

Publications:

1. Musselman, R.C., and T.J. Minnick. 2000. Nocturnal stomatal conductance and ambient air quality standards for ozone. Atmospheric Environment 34:719-733
2. Minnick, T.J., and D. P. Coffin. 1999. Geographic patterns of simulated recruitment of two *Bouteloua* species: Implications for distributions of dominants and ecotones. Journal of Vegetation Science 10:343-356.
3. Minnick, T.J. 1998. Abiotic Factors Affecting Distribution and Dominance Patterns of Two C_4 Perennial Grass Species. Ph.D. Dissertation. Colorado State University, Fort Collins, Colorado.

EXTERNAL REVIEW OF THE ENVIRONMENTAL SCIENCE AND TECHNOLOGY PROGRAM AT MESA STATE COLLEGE

Will Focht, Ph.D.
Director, Environmental Science Graduate Program, Oklahoma State University

Executive Summary

Mesa State College's strategic plan begins with a quote from Leonard Sweet: "The future is not something we enter. The future is something we create." The responsibility for creating a better future for the fourteen-county region that MSC serves is consistent with the Environmental Science and Technology (EST) program's mission of preparing tomorrow's environmental professionals. The field of environmental science is concerned with the interface of human and natural systems. The goal of environmental science is to maintain the health and integrity of this interface so that human quality of life can be sustainably improved. Environmental science, therefore, is essential to creating a better future.

A program review presents an ideal opportunity to examine where the program is heading and whether changes in direction are needed. This review reveals that an impressive collection of interdisciplinary courses comprises the EST curriculum. The EST program's integration of natural sciences focuses on both of the main interactions of human and natural systems: pollution and resource conservation. The applied experiences that all three faculty members bring to their courses enhances their value significantly. The program's three faculty members are competent in interdisciplinary teaching and mentoring and their career experience outside of academia is a powerful asset both in and out of the classroom. All graduates desiring an environmental career have succeeded in gaining employment in the field. This is indeed an enviable record of success.

Nevertheless, the program should now consider directing its resources to taking advantage of new opportunities that are likely to arise over the next five years relating to the rapid growth in the region. I suggest that the program seek to enter into multiple partnerships and collaborations outside of MSC to advance sustainable development. Such collaborations could include, but not be limited to, high schools, community colleges, other regional colleges and universities, local businesses, extraction industries, tourism interests, retirement communities, ranching and farming operations, service industries, medical organizations, educational institutions, and government agencies. The EST program should also seek to exert a more demonstrable impact in the region, particularly in sustainable development, pollution prevention and abatement, resource conservation, and ecosystem restoration.

The major problem facing the program concerns not the curriculum (as is the case with most other programs with which I am familiar), but rather student enrollment. Over the last five years, enrollment has fallen 40%. Though the program remains the largest of the four programs administered by the Department of Physical and Environmental Sciences, the enrollment decline is troublesome. This decline is due not to problems of retention, but rather recruitment. This report offers several suggestions for improving recruitment. Among these are redesign of the introductory ENVS course, more aggressive marketing, establishment of new credit and non-credit course initiatives, increased use of distance education, close attention to course scheduling, increased collaboration with program stakeholders and partners, stronger relationships with alumni, and increased fundraising activity.

Interdisciplinary program success cannot be fully captured using only one or two metrics of productivity such as student/faculty and program cost/student ratios. This report suggests other metrics of productivity that should be used to judge the quality of this program. Such metrics include course preparations, fundraising, stakeholder satisfaction, entry of graduates into environmental careers, and others.

Program improvement will require the faculty to dedicate its time to negotiating partnerships, developing marketing materials, developing strategic plans and resource justifications, and pursuing new academic initiatives. It is important that faculty be provided course releases to accomplish these activities over the next year or two. These course releases need not compromise student matriculation or ENVS credit hours if they are appropriately selected.

Introduction

I was retained by Mesa State College (MSC) to conduct a review of the Environmental Science and Technology (EST) program, located within the Department of Physical and Environmental Sciences. This review is based on documents provided before and during my site visit as well as on conversations held during the visit on October 8-9, 2007. I met with administration officials, program faculty, faculty representatives from the College's Curriculum and Assessment Committees, program students and alumni, and staff from Institutional Research, Library, and Information Technology. A detailed itinerary follows.

DATE	TIME	REPRESENTATIVES	TOPICS
Oct 8	8:00 – 8:10 am	Russ Walker, PES Head and EST program director	Travel from hotel to campus
	8:15 – 10:00 am	Russ Walker	Breakfast and overview of program
	10:00 – 10:25 am	Carol Futhey, VPAA	Discussion of review
	10:25 – 10:40 am	Tim Foster, President, and Carol Futhey	Discussion of review
	10:45 – 11:50 am	Sue Yeager, Chair of Curriculum Committee; Bill Tiernan, Faculty Senate	Discussion of curriculum development and review procedures
	12:00 – 1:00 pm	Russ Walker and Deb Kinnard, EST Faculty	Lunch and curriculum discussion
	1:00 – 2:00 pm	Russ Walker and students	Observation of teaching
	2:00 – 2:45 pm	Elizabeth Brodak, Library Director; Jamie Walker, EST Liaison; Jeremy Brown, IT Director	Discussion of library and IT services
	3:00 – 4:30 pm	Russ Walker, Deb Kinnard, and Tamera Kinnick, EST faculty	Discussion of curriculum
	4:30 – 6:00 pm	Alumni	Comments on program
	6:00 – 6:15 pm	Deb Kinnard	Transport to hotel
Oct 9	8:30 am	Deb Kinnard	Pick up from hotel
	8:40 – 9:00 am	Deb Kinnard	Campus tour
	9:00 – 10:00 am	Students	Comments on program
	10:00 – 11:30 am	Russ Walker	Discuss program collaboration opportunities, outreach, marketing, and degree options
	11:30 – 12:00 am	Sonia Brandon, Institutional Research Director; Jessica Herrick, Assessment Coordinator	IR services, assessment metrics, and assessment procedures
	12:00 – 1:30 pm	Russ Walker, Tamera Minnick, and Deb Kinnard	Lunch and discussion of program vision, metrics of success, enrollment, and resources
	1:30 – 2:00 pm	Russ Walker	Discussion of sustainability opportunities in the region and EST role
	2:00 – 2:45 pm	Alone	Prepare for exit interview
	2:45 – 3:15 pm	Julie Fredlund	Discussion about staff support\
	3:15 – 3:40 pm	Alone	Prepare for exit interview
	3:40 – 4:15 pm	Cathy Barkley, Assistant VPAA; Russ Walker	Exit interview
	4:30 – 5:00 pm	Tamera Minnick	Discussion of curriculum and program success metrics
	5:00 pm	Russ Walker	Travel to airport

On Program Mission

The overview of MSC presented on page 7 of the MSC Catalog states:

> *By promoting the acquisition of skills as well as the discovery and application of knowledge, the College develops the intellectual, ethical, and aesthetic sensibilities that enable a student to pursue a rewarding career and assume a responsible and productive role in society. The College seeks to liberate persons from narrow interests and prejudices, to help them observe reality precisely, to judge opinions and events critically, to think logically, and to communicate effectively. The College offers programs of value in areas of civic and cultural life, research, and recreation, and desires to play a constructive role in improving the quality of human life and the environment.*

This laudable and well-articulated vision could be better incorporated into the EST curriculum. Currently, ENVS courses are dominated by natural sciences. I recommend that these courses be modified, where appropriate, to add considerations of policy, economics, quality of life, and culture to make them more robust and relevant to informed citizenship. I am not suggesting that natural science rigor be lessened; rather I am suggesting that social relevance be added to reinforce the relationships between human and natural systems.

On Curriculum

Interdisciplinarity

Environmental science education is necessarily an interdisciplinary enterprise. Its success lies not in depth in a single discipline but an integration of several disciplines to better understand the functioning of complex systems. Interdisciplinary curricula include courses that are themselves interdisciplinary, i.e., they include content from several disciplines organized so as to reveal systemic relationships organized around a single theme such as watershed management or ecosystem restoration. Many programs struggle to develop truly interdisciplinary courses, opting instead for a multidisciplinary approach that includes several single disciplinary courses. Multidisciplinary curricula fail because students are left to integrate disparate disciplinary knowledge and discover systemic relationships by themselves.

The EST program has achieved a remarkable level of interdisciplinarity in its curriculum. The program faculty is commended for its development of sophisticated and comprehensive interdisciplinary courses that prepare students for competent service as environmental professionals.[1] This achievement is all the more noteworthy in that it was accomplished through the efforts of only three faculty members.

Program Concentrations

The program currently offers three areas of concentration: environmental restoration and waste management (ERWM), environmental science (ES), and environmental education (secondary teaching certificate).

The ERWM concentration focuses on human impacts on the natural environment (e.g., pollution and remediation) and is the oldest of these areas. The ES concentration is newer and focuses on natural resources (e.g., conservation and ecosystem restoration). The number of students enrolled in ERWM has declined in recent years whereas the number enrolled in ES has grown; ES enrollment now exceeds that in ERWM. Interestingly, most ES graduates end up in careers more appropriate to ERWM graduates. Examination of the curricula in these two concentrations does not reveal enough difference to prevent graduates of either to enter into environmental careers in both areas. Therefore, I recommend that these two concentrations be combined into one, whose focus is on the interactions of human and natural systems via both pollution impacts and natural resources.

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[1] It is important to note that environmental science and the environmental profession should not be confused with environmentalism and environmental advocacy. Environmental science is a rigorous and scientifically legitimated field of inquiry into the complex relationships between human and natural systems. Environmentalism is an ideology and social movement that seeks social change to reduce human impact on natural systems. Environmental science takes no normative position on change; rather, it seeks to inform deliberations about change.

The environmental education concentration has graduated only one student to date, and two more students will graduate by Spring 2009. The program should revisit the original rationale for the creation of this concentration to decide whether the program should continue. If it should continue, a strategy for improving enrollment should be developed. My personal bias is that this concentration should continue but it will need more support from education constituencies outside of MSC.

Finally, I recommend that EST establish a new concentration in sustainability. The region served by MSC is undergoing rapid growth, which creates a critical need for sustainable development in order to avoid repeating the mistakes of the past. Moreover, sustainable development is a "hot" area in environmental science now and MSC should take steps not to be left behind. Finally, sustainability, when properly conceived, is the best way to think about integrating economic prosperity, social well being, and environmental health in the common pursuit of continuing improvements in quality of life. As such, sustainability should garner ample support from business, energy industry, agriculture and ranching, mining, tourism, retirement, and government sectors alike.

External Advisory Board

I strongly recommend that the EST program recruit successful environmental professionals to an external advisory board that can provide suggestions to the program about its curriculum, career trends, marketing, recruitment, resource needs, partnerships, and fundraising. It is important that the program maintain a communication channel with the region to assure competence, compatibility between curriculum and professional advancements, and responsiveness to regional needs.

Course Content and Pedagogy

Former and current students are generally satisfied with the technical content and relevancy of the courses offered by the EST program. They believe that the curriculum adequately prepares them for careers in the environmental profession.

I asked students if they thought that the EST curriculum focuses too much on the public sector. The students were surprised by the question and reported that perhaps it focused too little on the public sector. It is important that both private and public sector issues are included in the curriculum and that the mix of public and private sector opportunities is appropriate. I do not recommend any change in this area.

Though students admit that the curriculum is not aimed at graduate school preparation, they state that the faculty is quite willing to work with them individually if they were interested in an advanced degree. I can assure the program that its training in environmental science is quite adequate for admission to graduate school. I would be happy to admit any student who succeeds in the EST program at MSC to my graduate program at Oklahoma State University.

The capstone course is a valuable conclusion to the EST program. Care must be taken however to ensure that the client is clear about its role in the internship and that the student and client reach agreement early on what is expected.

I suggest that the faculty explore adding new courses, or modify existing courses, to deal with NEPA environmental impact assessments and ISO 14001 environmental management systems as these are important career opportunities.

Students are quite satisfied with the quality of teaching in courses at MSC and in the program. They appreciate the real-life experience that the faculty brings to its courses. They are particularly impressed with the willingness of the faculty to allow students to enroll in individualized structured-research classes when normally scheduled classes are canceled or conflict with other important classes occurs. The students did suggest however that the teaching of the Characterization of Contaminated Sites course should be improved.

I congratulate EST faculty members for their commitment to students and their willingness to accommodate students' individual needs. Their practical experience in the field is a welcome addition to the expertise that they bring to instruction and mentorship.

Learning Outcomes Assessment

The EST program administers tests of knowledge of new majors and then retests them near the time of their graduation. Results indicate that new majors achieve an average score of 63%. This suggests that the test is not rigorous enough and deflates its usefulness as an instrument to measure knowledge acquisition. I recommend that the test be made more difficult so that the value of the program can be more accurately and comprehensively measured.

Distance Education

Distance education has been conducted on an older version of WebCT. I understand that IT has recently upgraded to a newer version of WebCT (version CE 6). Distance education is a useful way to recruit students and serve a wider audience. I recommend that the EST program should explore the offering more distance courses.

Encouragement of faculty to offer distance education courses depends in part on the ease of use of the distance education platform. IT should continue to explore adoption of platforms that are flexible and easy to use. Desire-to-Learn is one such candidate.

General Education Requirements

All MSC students must complete 34 hours of general education courses that include 7 hours in the natural sciences. This requirement applies even if the student is majoring in environmental science and the content of these courses are covered in the ENVS courses. The outcome of this situation is that EST students are forced to take single-discipline science courses at the expense of important interdisciplinary science courses, which are the foundation of the EST program. By eliminating the gen-ed natural science courses, EST students could take two more ENVS courses, which would increase the number of student credit hours recorded in these courses.

The EST program should also investigate whether one or more of its courses could be designated as a general education requirement for other majors, or at least serve as valuable electives.

Math Requirements

EST students believe that required electives in math and statistics (e.g., STAT 200) should be dropped. ENVS classes (particularly those offered by Dr. Minnick) provide sufficient coverage of these areas. If math and statistics courses are indeed not important prerequisites for ENVS courses, then I agree that they should be dropped as a program requirement. This change would also allow students to take more ENVS courses and thus increase the number of credit hours taken in the program.

Course Consolidation

Current students suggest that ENVS 200 and 221 be consolidated into one course by eliminating some of the fieldwork components. I recommend that the program should consult with alumni and employers about the importance of fieldwork to determine the optimal mix of knowledge acquisition and field application.

Course Scheduling

One student reported that environmental chemistry is not offered frequently enough and that lecture/lab courses sometimes overlap. However, the students also recognize that the EST lacks enough professors to offer more sections at a time or courses more frequently. I recommend that students, alumni, and employers be consulted to determine appropriate course frequency and timing so as to maximize benefit to students.

Course Registration

Current students are rather emphatic that the course schedule severely restricts freshmen interested in an EST degree from registration in required courses. This forces them to "burn up" their elective hours early in their program. This limits the number of electives that they would like to take in their junior and senior years after they have become better informed about the courses they would like to take. I recommend that the EST program (and affiliated programs) make it easier for freshmen to enroll in required courses – either by offering more sections or expanding the number of students who can enroll in a section – so that electives can be preserved for later in students' matriculation through the EST program.

Anticipation and Adaptation

Western Colorado is undergoing rapid change and growth. This presents both a challenge and an opportunity to the EST program. The challenge is to anticipate the direction and magnitude of change and to adapt the program's curriculum to it. Successful adaptation will allow the program to take advantage of new niches in order to grow the program.

In particular, unplanned growth during previous boom and bust cycles creates an opportunity to learn from past mistakes and pursue more rational growth strategies that will yield long-term benefits. I recommend that the EST program (along with other programs at MSC) join with various public and private sector planners, developers, investors, technologists, and other stakeholders in the design and deployment of more sustainable development plans, technologies, and practices.

On Enrollment

MSC is dissatisfied with the size of student enrollment in the EST program. Enrollment figures provided by Institutional Research confirm an enrollment declining from 75 in fall of 2003 to 42 in fall 2007. Nevertheless, enrollment in the EST program over the last decade has been, and continues to be, the largest program in the department (geology = 40, chemistry = 35, physics = 25).

I did not find any obvious retention problem that is unique to EST. Approximately 70% of EST sophomores go on to graduate, which was reported to me as similar to other departmental graduation rates. The faculty is congratulated for its work in moving students to graduation. I recommend however that students who quit the program be interviewed to identify reasons for leaving. These reasons may point the way to increasing retention.

This leaves recruitment as the primary challenge to increasing enrollment. Suggestions for improving program enrollment follow.

Switch ENVS 110 and ENVS 210

ENVS 110 is the first course required of EST majors and thus is an ideal vehicle to recruit students into the program. Recently however, the number of students recruited has declined to only two out of 30 thirty per semester. Current students and alumni report that some students find the course dull and elementary while others find it too technical. Ideally, this course should excite and inspire students to become EST majors. As it is currently structured, the course instead exposes students to environmental science as a science and introduces them to environmental research methods and scientific reporting. While this is indisputably important to competence as an environmental science professional, it is not necessary in the first course.

ENVS 210 is the second course for EST majors. It offers a survey of the environmental science field and exposes the students to career opportunities. This is much closer to what the first course should do.

Therefore, I recommend that these two courses be switched, renumbered, and appropriately modified so that the new ENVS 110 serves as a stimulus for program enrollment. I do not suggest that the course be made less rigorous. On the contrary, it should provide an exciting description of the full breadth of the field, the challenges that are presented in it, and the opportunities for rewarding careers. Qualified alumni and employers could deliver guest lectures. Field trips to work sites should be offered. Each student should prepare a report on an interesting (to the student) subfield of environmental science, which describes the subfield's contribution to the achievement of environmental goals, summarizes the knowledge and skills required for career success, explores possibilities for useful professional experiences, anticipates opportunities for career advancement, and so on. Such a survey course, properly designed and offered, can help students discover how environmental science can serve both the student's individual interests and career aspirations.

Marketing Message

Part of the reason that EST enrollment is not higher is cultural and historical. I was told that enforcement of environmental regulations in the region is less than aggressive. Moreover, the regional political culture tends toward individualism, which is not typically hospitable toward government intervention in the economy. If this is true, then the EST program should adopt a recruitment strategy that embraces sustainable development (the achievement of both economic growth and environmental quality). Initiatives labeled as smart growth, low impact development, design for the environment, industrial ecology, sustainable development, renewable energy, resource conservation, pollution prevention, green manufacturing, green product design, green architecture, and sustainable communities all seek to advance environmentally benign economic development strategies to improve quality of life.

Recruit beyond the Fourteen-County Region

I asked current students why they chose MSC and the EST program. Reasons for choosing MSC included residence nearby, desire to attend a small-town college, and regional quality of life. Reasons for choosing the EST program included desire to work out-of-doors, interest in environmental issues, and availability of a teacher certification in environmental science. The students report that the EST program is not well known outside of the region. These findings suggest that MSC should do more to advertise its programs, including the EST program, outside of the region. MSC and the region have much to offer to students from other parts of the State and environmental issues are growing in importance among students everywhere. Coupling the high quality of life associated with the natural environment in the region to the growing awareness of environmental issues among the public provides a perfect opportunity to recruit students to MSC's EST program.

Intensify Recruitment in High Schools

Current students indicate that high school students are generally ignorant of, or confused about, environmental science. Many believe that environmental scientists are radical environmentalists ("tree huggers"); this belief discourages consideration of environmental science as a major and career. Alternatively, other students assume that environmental science is not a rigorous scientific field and thus seek other scientific degrees. Such popular misconceptions must be overcome early in order to attract EST majors. EST alumni agree that marketing of the program to high schools has been unimpressive. I therefore recommend that MSC immediately embark on an aggressive marketing campaign in high schools to educate students about what environmental science is and the careers available in it, with the specific goal of dispelling misconceptions.

Pursue Other Marketing Opportunities

MSC should work with EST to develop public marketing campaigns that could attract students to the EST program along with other programs.

The EST program should also consider establishing an alumni association. Such an association can provide at least three benefits. First, alumni can help recruit new students to the program. Second, alumni can employ and sponsor internships for current students. Third, alumni can support the program through financial gifts and in-kind donations of services and equipment.

In addition, the EST program should encourage the establishment of an environmental science student organization. This builds a sense of community among students, encourages a sense of loyalty to the program and to each other, empowers students to participate in program activities, and fosters their active involvement in an alumni association after graduation. The organization can also help with student recruitment through its activities both on and off campus.

Finally, the EST program used to participate in an environmental design competition that stimulate student interest and inspired their creativity. Several years ago, however, their participation was halted due to lack of student interest. I recommend that the program consider restarting participation in this or other contests to stimulate student involvement, build awareness of the program, and improve program reputation.

Develop Certificate and Continuing Education Programs

Professional certificates and seminars are two other ways to grow the EST program by providing opportunities for working environmental professionals to update their knowledge and skills. Certificate programs will increase enrollment in those courses included in the program. Continuing education short courses and seminars can attract students to the degree and certificate programs. Both initiatives will increase the visibility of the program and address a niche that is not being served now in the region.

Market the EST Minor

The EST program should consider recruiting more students to enroll in a minor in environmental science that could attract students from other majors. The program should work with other departments to determine their interest in collaborating in such a minor. The program should also develop posters, brochures, and other materials that can attract interest in its minor.

Restore the Associate Degree

The EST program should consider restoration of an associate (AAS) degree in environmental science. This vehicle would attract more students and serve as a recruitment tool for the four-year degree program. The associate degree would also provide a gateway for students who need more preparation for baccalaureate programs to increase their skills and knowledge. The program should work with the Bureau of Land Management, US Fish and Wildlife Service, Bureau of Reclamation, US Geological Survey, Colorado Division of Wildlife, and regional businesses to define the associate degree program and recruit students to it.

Consider Establishment of a BA Degree

The EST program should consider offering a BA degree in environmental science. As stated above, the environmental field is concerned with the interaction of human and natural systems. Some environmental science programs tend to look at these interactions from a natural science perspective. Other programs look at the interactions more from a social science perspective. In either case, science is at the core of their investigations.

The BA program I recommend would emphasize economics, planning, law, policy analysis, risk perception, communication, conflict management, community relations, governance, stakeholder participation, quality of life assessment, natural capital valuation, decision sciences, and other elements of social systems as they relate to the environment.

The BS degree would retain its focus on the natural sciences such as earth sciences, life sciences, geography, pollution control and prevention, ecosystem restoration, ecosystem modeling, risk assessment, risk management, climate change, and conservation technologies.

Both degree programs would study the human-nature interface and thus would include applied science courses in natural ecology, human ecology, pollution ecology, conservation science, and engineering science.

I should add a caveat here. BA degrees sometimes carry a stigma as being less rigorous than BS degrees and therefore create a disincentive to both prospective majors and potential employers. If the EST creates a BA degree program, it should work with potential employers to design marketing strategies that communicate the value of the social sciences in dealing with the complex environmental challenges that face us. It is important to emphasize that technology alone will not solve environmental problems; behavioral change is also essential. Therefore, the behavioral sciences have an essential role to play in fashioning and successfully implementing solutions to problems of pollution and resource depletion.

On Metrics of Program Success

MSC generates metrics to measure program success such as student/faculty and program cost/student ratios. However, success can be defined in many ways. It is important to create metrics that tap into these alternative definitions of success. The Institutional Research Director stated that new metrics can be generated at the request of departments and that databases can be modified or created to store data that can be used in calculating these new metrics.

I recommend that the EST program enter into discussions with MSC administration, faculty, students, alumni, employers, donors, advisors, and members of the general public about definitions of success and then develop appropriate metrics. For example, internal metrics aimed at assessing the donations that have been given to the program, faculty service to the field (e.g., guest lectures, professional service, community service), outreach to the region (e.g., community-based learning, service-learning, internships, field projects), alumni satisfaction, client satisfaction, number of field and lab projects designed in courses, number of course preparations, number of independent study courses offered, number of new course preparations, student evaluations of courses, and number of career placement activities are some of the metrics that can be added to the existing metrics to demonstrate program productivity. External metrics that demonstrate impact in the region are also important. Such metrics could include percentage of graduates finding employment in the environmental profession, business start-ups by graduates, number of persons taking professional development seminars and short courses, employer satisfaction, estimates of environmental risk reduced through EST projects, number and scale of sustainable development projects in which EST was involved, and so on.

On Resources

Resources and productivity are, of course, recursively linked. Without resources, productivity is stifled. Without productivity, resources are wasted. More resources should stimulate productivity, which will stimulate the production of more resources. The key to program success is to allocate resources efficiently so that they are not wasted and productivity is maximized. A program must make a successful case for resource additions based on the likelihood of achieving compensating benefits. What constitutes a benefit and how benefits should be measured must be determined *a priori*.

I recommend that the EST program think of resources as investments in productivity rather than entitlements. I also recommend, however, that EST be forthright in developing rationales for the allocation of resources. This will involve development of rational plans that justify investments with a high probability of productivity gains. Here are my suggestions for resource allocations.

EST Program Administration, Staff and Faculty Workload

The head of the Department of Physical and Environmental Sciences, which houses the EST program as well as programs in geology, chemistry, and physics, will teach 12 semester hours each semester this academic year. I recommend that the department head teach at least one less course each semester to engage in strategic planning for improvement of the program. Otherwise, it is difficult to see how he could devote sufficient time to implement the suggestions offered in this review. I would also recommend that the program coordinator also be granted a course release each semester for the next year or two to dedicate time to program improvement.

The department employs one administrative staff member who dedicates about 15% of her time to the EST program. She spends most of her time providing room access to students (using key cards) and advising students on courses. I believe that she is under-utilized by the program. I recommend that the department head, program coordinator, and third faculty member delegate more work to her. For example, she could assist in student recruitment (e.g., help prepare and distribute video and brochure marketing materials) and process student admissions. A student work-study could be hired to help her if the work rises to justify it. Work-study students could also be used to help more with grading and lab preparation. Increased delegation by faculty would free up time for other activities aimed at program improvement.

The average teaching load is 12 hours per semester, which amounts to four preparations per semester since multiple sections of ENVS courses are not offered. This does not count student advisement, independent study courses, and professional service. Such a workload does not leave much time for new initiatives. I recommend that release time or overload compensation be provided to faculty members who submit high quality proposals to grow and improve the program. Careful course scheduling and/or judicious use of adjunct instructors would of course be required.

I believe that it is important to recognize that the development of an interdisciplinary curriculum is much more challenging than a unidisciplinary curriculum that relies on existing texts, teaching techniques, and application activities. In many cases, high quality teaching materials do not already exist, which requires the faculty member to develop these *de novo*.

Library and IT Support

The library serves departments through library liaisons that work with departments to order materials and provide support. The library also allocates funds to each department for purchases. Journal subscriptions are funded from college resources. Interlibrary loans are free to faculty. The library subscribes to 70 databases, many of which contain full text articles, which are searchable through an online reference service. Library research is facilitated through "Jump Start" on the library's home page.

At-risk students are referred to an advising center through the "early alert" system.

IT reports that it replaces all personal computers no less frequently than six years, using standard configurations. Software upgrades are free. A new web portal is under construction to standardize the look and feel of MSC websites.

It appears to me that the library and IT departments offer high quality support to the EST program. However, I understand that the library does not subscribe to some of the journals that are important to the faculty. While I was not provided a complete list of these (*Ecological Applications* and *Journal of Range Management* are two that should be added), I recommend that the program work with the library to carry or provide electronic access to those that are needed.

Use of a Van for Transport of Students to Field Sites

The EST program needs access to another van to transport students to field sites. EST offers ten field courses – seven of which are offered in the fall semester. I was informed that it is not uncommon that a van is not available for some of these trips. Ideally, the program would own its own van; alternatively, it would share a van with one or more departments that also operate field courses. The program could assist in the effort to obtain a dedicated van by soliciting donation of a van or money dedicated to a van purchase.

Fundraising

The EST could do more to raise external funds for its operation and growth. Three opportunities should be investigated and pursued. First, the program should recruit an external advisory board. Such a board, properly constituted with successful alumni and other benefactors who want the EST program to succeed, can both provide valuable advice for the direction of the program but also help solicit funds for program activities. Second, the program should establish an alumni association, which can also provide financial and other support. Third, the program should seek to enter into partnerships with more employers, internship sponsors, and environmental service providers to mutual advantage.

Faculty Hire

I recommend that the program develop a convincing case for the employment of one additional faculty member to teach courses that focus on human systems related to the environment. I recognize that it is important to tie faculty positions to student enrollment. This presents a chicken-and-egg problem however: more faculty could teach more courses which could draw more students – but more students are needed to justify more faculty. I suggest that the problem should be addressed from both ends simultaneously. In other words, the program should develop a convincing justification for a new faculty member (e.g., new courses to be offered, improved curriculum quality, new research interests, new collaborative opportunities) along with a rational plan for improving student enrollment (e.g., new degrees, professional certificates, professional development seminars, improved marketing, improved alumni and employer relations, new collaborative partnerships, creation of an external advisory board, and so on). In particular, I recommend that the program seek to decrease its reliance on other departments to provide foundation courses based on single disciplines and instead develop its own interdisciplinary courses that integrate several disciplines. This would increase the number of student hours in ENVS courses.

Future Faculty Hiring Priorities

I have already stated that the EST program should be commended for their development and implementation of an interdisciplinary curriculum. However, an even better curriculum could be developed if the faculty were more interdisciplinarily trained. I therefore recommend that future faculty hires be restricted to interdisciplinarily-trained candidates. This makes development of interdisciplinary courses much easier and provides improved mentorship of interdisciplinary students.

Internal Partnerships

I recommend that the EST program do more to explore partnership opportunities with the Petroleum and Energy Land Management and Construction Management concentrations in the bachelor of business administration program, and the Natural Resources Institute in the Social and Behavioral Sciences Department – especially as these relate to sustainability.

External Partnerships

I recommend that the EST program take the lead in encouraging MSC to form an inter-departmental Task Force on Sustainability. Since the region is undergoing rapid growth, the time is ripe for a focus on sustainable development. The Task Force should involve faculty from business administration, natural resources institute, energy land management, policy programs, and other programs to coordinate sustainability research, education, and outreach. It should seek to enter into partnerships with outside organizations (businesses, landowners, government agencies, investors, etc.) to investigate development strategies that foster both economic return and environmental quality. To kick things off, the Task Force could help sponsor a regional sustainable development conference to define an agenda for advancing sustainability and to recruit participants to that effort.

Conclusion

The EST program is healthy and well designed but it needs to do more to grow enrollment and obtain resources. Continuing declines in enrollment will threaten its existence. Fortunately, the convergence of ascendant awareness of environmental issues among the public, rapid population and economic growth in the region, and dedicated program faculty and staff provide an opportunity to strengthen the program. The faculty should dedicate some of its time to planning, forging productive partnerships, and aggressive marketing to a wider audience. With the cooperation of other units at MSC and partners outside of the College, I believe that the EST program will continue to prosper.

I want to thank Mesa State College, and in particular Assistant Vice President Cathy Barkley, for extending this opportunity to review the Environmental Science and Technology program. I also want to thank the program's faculty and students, and other members of the MSC community, for their cooperation. The program coordinator, Russ Walker, was gracious, accommodating, patient, and responsive to my inquiries, which I sincerely appreciate. I always learn much from these program reviews and the present case is no exception. If I can assist further, please do not hesitate to ask. I look forward to hearing about how the program fares as it moves forward.

Will Focht
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