AY 2012 – 2013
Program Review

Physical Sciences

PROGRAM REVIEW
2012

BACHELOR OF SCIENCE IN PHYSICAL SCIENCES

COLORADO MESA UNIVERSITY

Prepared by

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Contents

Tables

Appendices

A. Introduction and Program Overview

1. Program description

The Bachelor of Science (BS) in Physical Sciences is the degree awarded to students who complete the requirements of one of the following five concentrations:

- Chemistry
- Physics
- Geology
- Environmental Geology
- Geology, Secondary Teaching

Although we offer *concentrations* in each of these disciplines rather than stand-alone degrees, the requirements of each concentration are comparable to those one would find for stand-alone degrees in that discipline at other colleges and universities across the nation.

The following minors are also administered by faculty in chemistry, physics, and geology:

- Chemistry
- Physics
- Geology
- Geographic Information Science and Technology
- Watershed Science

An Associate of Science degree with a major in Liberal Arts is offered with an emphasis in either geology or physics. A certificate is available in Geographic Information Science and Technology in addition to the minor.

The administrative unit that houses these degree programs is the Department of Physical and Environmental Sciences, which also includes degree programs in environmental science and mechanical engineering. Although chemistry, geology, and physics are all part of the same degree program and overseen by a single department head, they are managed as independent units. Each program has its own faculty, labs, and budget, controls its own curriculum, schedules its own classes, and sets its own priorities.

2. Program history

Prior to 1993, geology and physics were areas of emphasis along with mathematics and computer science under the Bachelor of Science in Physical and Mathematical Sciences. There was no degree program for chemistry, although a limited number of chemistry courses were offered. The Bachelor of Science in Physical Sciences was first offered in the fall of 1994. The degree initially included concentrations in geology and physics. With the implementation of a concentration in chemistry in the fall of 1995, the degree took on the basic framework that it has today.

Additional concentrations related to physics and geology were added later. Environmental geology was implemented in 1995 in order to provide a more specific program of study for geology majors planning to work in the environmental profession. In order to provide and promote opportunities in the sciences for secondary teaching candidates, geology and physics

implemented their concentrations in secondary teaching in the fall of 1997. A concentration in applied physics was also implemented in that year to provide a track for physicists seeking careers in engineering and other applications of physics. However, the concentrations in applied physics and secondary teaching in physics were deleted, effective in the fall of 2004.

3. Mission and goals

The mission assigned to CMU by the Colorado Legislature includes the statement "Colorado Mesa University shall offer liberal arts and sciences programs". Our B.S. in Physical Sciences is a direct fulfillment of this mandate. Chemistry, physics, and geology (sometimes in the form of earth science) are found in the majority of U.S. colleges and universities that share the liberal arts and sciences mission.

The University's philosophy and goals of a baccalaureate education includes seven emphases (2012-2013 Colorado Mesa University Catalog, page 46), at least three of which are directly supported by the B.S. in Physical Sciences. We strive to convey "the scientific perspective" in all of our courses (those for general education as well as those for majors), with attention to "its impact on society" when appropriate (e.g., in GEOL 107 Natural Hazards and Environmental Geology). Our courses for majors are clearly devoted to "advanced competencies within a specific discipline". We strive to equip students not just with facts, but with "the competencies needed for self-directed, ongoing learning".

The goals of the physical sciences programs are:

1. To prepare students for professional or technical careers in chemistry, geology, physics, and related disciplines.

2. To prepare students for graduate study in chemistry, geology, physics, and related disciplines.

3. To prepare students for careers as teachers.

4. To provide students with a liberal arts education which, while focused on scientific disciplines, includes tools for critical and creative thinking as well as important perspectives on our culture.

To accomplish these goals, the physical sciences faculty requires students to: 1) demonstrate a mastery of the body of knowledge that defines the essence of one of the concentrations; 2) develop analytical problem-solving and critical reasoning skills that are essential to define and solve scientific problems and conduct scientific research; 3) demonstrate proficiency in the use of relevant technology; and 4) develop oral and written communication skills. As a means of enabling student success, we promote student participation in structured research projects outside of normal classroom activities. We find these projects to be highly effective in developing the desired breadth of student abilities, and they create a sense of energy and vitality that excites and motivates students.

4. Support of other programs

The chemistry, geology, and physics programs provide twenty-one of the twenty-six courses that CMU students may take to fulfill the general education requirement in the natural sciences (Table 1); the other five courses are provided by the biology and environmental science programs. Students must take two of these courses, of which at least one must have a lab. Without counting laboratory section enrollment, in Academic Year 2012 (AY12) chemistry had 765 students, geology had 1,817 students, and physics had 813 students enrolled in these courses for a total of 3,395 students.

Table 1. General Education Courses in Chemistry, Geology, and Physics

Prefix	Title
CHEM 100	Chemistry and Society
CHEM 121, 121L	Principles of Chemistry, Lab
CHEM 122, 122L	Principles of Organic Chemistry, Lab
CHEM 131, 131L	General Chemistry, Lab
CHEM 132, 132L	General Chemistry, Lab
GEOL 100	Survey of Earth Science
GEOL 103	Weather and Climate
GEOL 104	Oceanography
GEOL 105	Geology of Colorado
GEOL 106	Introduction to Dinosaurs
GEOL 107	Natural Hazards and Environmental Geology
GEOL 111, 111L	Principles of Physical Geology, Lab
GEOL 112, 112L	Principles of Historical Geology, Lab
GEOL 113, 113L	Field-Based Introduction to Physical Geology
PHYS 100	Concepts of Physics
PHYS 101	Elementary Astronomy
PHYS 105, 105L	Physics by Inquiry, Lab
PHYS 111, 111L	General Physics, Lab
PHYS 112, 112L	General Physics, Lab
PHYS 131, 131L	Fundamental Mechanics, Lab
PHYS 132, 132L	Electromagnetism and Optics, Lab

Many courses in chemistry, geology, and physics are required or listed as options by other degree programs, such as biology, environmental science, engineering, and teacher certification (Table 2).

Table 2. Courses in Chemistry, Geology, and Physics Supporting Other Programs

Course	Other Programs Listing Course as Requirement	Other Programs Listing Course as Option
CHEM 100	BA, Elementary Teaching, English BA, Elementary Teaching, Math BA, Elementary Teaching, Social Science	
CHEM 121, 121L	BS, Biological Sciences, Secondary Teaching AAS, Water Quality Management	BS, Environmental Science & Technology BS, Mechanical Engineering Technology AAS, Mechanical Engineering Technology
CHEM 122, 122L	BS, Biological Sciences, Secondary Teaching	
CHEM 123		BS, Environmental Science & Technology
CHEM 131, 131L	BS, Biological Sciences, Biology BS, Mechanical Engineering BS, Exercise Science BS, Physical Sciences, Geology BS, Physical Sciences, Environmental Geology BS, Physical Sciences, Geology, Secondary Teaching	AS, Liberal Arts, Biology BS, Mechanical Engineering Technology AAS, Mechanical Engineering Technology BS, Environmental Science & Technology
CHEM 132, 132L	BS, Biological Sciences, Biology AS, Liberal Arts, Biology BS, Exercise Science	BS, Environmental Science & Technology BS, Physical Sciences, Geology BS, Physical Sciences, Environmental Geology
CHEM 211, 211L	Minor, Forensics	
CHEM 300		Minor, International Studies Minor, Watershed Science
CHEM 315, 315L	Minor, Forensics	BS, Biological Sciences, Biology
CHEM 431, 431L		Minor, Forensics
GEOL 100	BA, Elementary Teaching, English BA, Elementary Teaching, Math BA, Elementary Teaching, Social Science	
GEOL 103		Minor, International Studies
GEOL 104		Minor, International Studies
GEOL 107		Minor, International Studies
GEOL 111, 111L or 113, 113L	BS, Biological Sciences, Secondary Teaching BBA, Business Adm., Energy Management/Landman	BS, Environmental Science & Technology
GEOL 112, 112L	BS, Biological Sciences, Secondary Teaching	
GEOL 321, 321L	Certificate and Minor, GIST	
GEOL 332	Minor, Archaeology	BS, Environmental Science & Technology Minor, International Studies
GEOL 355	Minor, Watershed Science	
GEOL 359		Minor, International Studies
GEOL 370		Minor, Watershed Science Technical Certificate, Sustainability Practices
GEOL 402, 402L		Minor, Watershed Science
GEOL 415, 415L		Minor, Watershed Science
GEOL 455, 455L	Minor, Watershed Science	

Table 2 (continued). Courses in Chemistry, Geology, and Physics Supporting Other Programs

Course	Other Programs Listing Course as Requirement	Other Programs Listing Course as Option
PHYS 100		BA, Elementary Teaching, English BA, Elementary Teaching, Math BA, Elementary Teaching, Social Science
PHYS 105, 105L		BA, Elementary Teaching, English BA, Elementary Teaching, Math BA, Elementary Teaching, Social Science
PHYS 111, 111L	BS, Biological Sciences, Biology BS, Biological Sciences, Secondary Teaching BS, Construction Management BS, Physical Sciences, Geology, Secondary Teaching	BS, Physical Sciences, Chemistry BS, Mechanical Engineering Technology AAS, Mechanical Engineering Technology BS, Exercise Science BS, Physical Sciences, Geology BS, Physical Sciences, Environmental Geology
PHYS 112, 112L	BS, Biological Sciences, Biology BS, Biological Sciences, Secondary Teaching	BS, Physical Sciences, Chemistry BS, Construction Management BS, Exercise Science BS, Physical Sciences, Geology BS, Physical Sciences, Environmental Geology
PHYS 131, 131L	BS, Mechanical Engineering	BS, Physical Sciences, Chemistry BS, Mechanical Engineering Technology AAS, Mechanical Engineering Technology BS, Physical Sciences, Geology BS, Physical Sciences, Environmental Geology
PHYS 132, 132L	BS, Mechanical Engineering	BS, Physical Sciences, Chemistry BS, Physical Sciences, Geology BS, Physical Sciences, Environmental Geology
PHYS 231	BS, Mechanical Engineering	

5. Locational and comparative advantages

CMU is located in a geologically diverse region that serves as a natural laboratory for geology. Collectively, geology courses include approximately 165 field trips each year (during lab periods and on weekends) to destinations that include the Colorado National Monument, the Bookcliffs, Arches National Park, Ouray, and Glenwood Springs.

6. Unusual characteristics

In addition to maintaining a full teaching load, nearly all members of the chemistry, geology, and physics faculty regularly supervise structured research and/or senior projects. (More detail is provided later in this report.) Classes for majors are small and students experience a great deal of close interaction with faculty. Our minor and certificate in Geographic Information Science and Technology and our minor in Watershed Science provide unusual opportunities for our students to supplement their major field of study.

7. Recommendations from 2006 review

Chemistry

Issue 1—There is too great a use of temporary full-time faculty members. The use of temporary full-time faculty disrupts academic continuity and challenges content quality, and should not exceed 15% of program instruction (national best practices are 10-20%).

> 2007 response—We agree. Chemistry currently has three tenured or tenure-track positions and one full-time temporary position. The latter position had been a tenure-track position until the spring 2002 semester, when the occupant resigned.
>
> Result—A fourth tenure-track chemist was hired in 2011 and a fifth tenure-track chemist in 2012, thus only one out of six full-time faculty are temporary faculty. Because of continued growth in demand for chemistry courses required by other programs, we do still need the full-time temporary position.

Issue 2—The current curriculum is weak in inorganic chemistry because no faculty member with that specialty has been retained. Faculty expertise in inorganic chemistry is also essential to accreditation by the American Chemical Society, should the program seek this status in the future.

> 2007 response—We agree.
>
> Result—The tenure-track chemist hired in 2011 specializes in inorganic chemistry.

Issue 3—Curriculum needs closer alignment with national standards, such as those provided by the American Chemical Society (ACS). Supporting curricular requirements in mathematics do not meet national standards. Decisions need to be made regarding a compromise between quality and quantity of graduates.

> 2007 response—We disagree with this comment. Our math requirements *are* in alignment with the ACS standards. With respect to physics, we allow chemistry majors to complete either the calculus-based or algebra-based versions of general physics. Our observation is that there is no significant degradation in the quality of our chemistry graduates who have had only the algebra-based physics. This practice is widespread nationally.

Issue 4—The ACS (American Chemical Society) provides nationally normed examinations for each course in the curriculum. Chemistry should take advantage of this and assess its students, its curriculum, and faculty by purchasing and administering these exams.

> 2007 response—We agree.
>
> Result—We have been using the ACS exams as a tool for course assessment in CHEM 132 General Chemistry II and CHEM 312 Organic Chemistry II since May 2007. We do

not use the ACS exam in CHEM 322 Physical Chemistry II because the multiple choice format of the test is a poor match for our preferred approach to year-end assessment of this course's content, which is to use multi-step mathematical problems. As for program assessment, we continue to use the Major Field Test in Chemistry.

Issue 5—There is an opportunity for chemistry to provide an alternate pre-health care curriculum at Mesa. Many students realize that a major in something besides life science gives them a competitive edge in medical or dental school acceptance. Chemistry is a natural discipline to offer a more rigorous preparation opportunity for these students.

2007 response—We agree.

Result—With the 2012 hiring of a tenure-track chemist specializing in biochemistry, we are now in a strong position to act on this opportunity. Work is underway on developing a curriculum that would be the basis for a proposal to the Curriculum Committee.

Issue 6—Chemistry has aging analytical equipment with no funding for replacement and maintenance.

2007 response—We agree.

Result—We will replace existing equipment and expand our equipment holdings through a combination of grants (such as those offered by the National Science Foundation) and funds from the CMU Foundation. As detailed in Section D.1.d, efforts to obtain grant funding for instrumentation have met with limited success. The CMU Foundation is actively soliciting contributions to the Physical and Environmental Sciences Legacy Fund, which will be managed as an endowment for equipment maintenance and purchase. Approximately $130,000 has been donated to this fund since its creation in March 2010, including $13,000 earmarked for the purchase of a used gas chromatograph-mass spectrometer (GC-MS) for Chemistry. We will look for opportunities to purchase other good used equipment as a way to stretch our funds.

Issue 7—More majors can be accommodated.

2007 response—We agree.

Result—Although we do not have a formal strategy for attracting a greater number of chemistry majors, our numbers have increased by 35% from 2007-08 (fifty-one majors) to 2011-12 (sixty-nine majors). We can readily accommodate more students in most of our courses for majors. However, enrollment increases in CHEM 211/211L Quantitative Analysis and CHEM 311/311L Organic Chemistry I are forcing us to offer additional lab sections, which adds to our problem of staffing all the lab sections that we need to provide.

Geology

Issue 1—Transportation for field-based curriculum is limited and difficult to arrange.

2007 response—We agree.

Response— CMU has purchased additional vans so that transportation for field trips is improved, but still not entirely sufficient. There continues to be a need for 4WD vehicles to access field areas. The geology faculty feels that the system used by the Purchasing Department to reserve vans is cumbersome, and that the current fleet of vans suffers from poor maintenance and upkeep. The price for using the vans for such an essential aspect of our teaching effort seems excessive.

Issue 2—Laboratory space is particularly limited requiring simultaneous laboratory instruction in the same space.

2007 response—We agree.

Result—Geology gained an instructional lab with the August 2010 completion of the addition to the Wubben-Science Center. The program also gained a smaller, multipurpose room that can be used for projects, research, and seminars.

Issue 3—Supporting curricular requirements do not meet national standards, such as those provided by the American Geological Institute.

2007 response—There are no national standards specified by the American Geological Institute or any other organization.

Issue 4—Decisions need to be made regarding a compromise between quality and quantity of graduates. Attracting students to the geosciences by reducing the requirements in mathematics, physics, and chemistry is NOT a good practice and will ultimately harm the geoscience program. I realize that this is not a simple issue, but discussion needs to occur to determine the program's strategic direction in this area. One possible solution is offering an emphasis in the geosciences directed at students interested only in post-baccalaureate employment. The purpose of this emphasis would need to be clearly articulated to students who choose it, because it would not provide adequate graduate school preparation.

2007 response—On the basis of our experience and student success, we continue to believe that our required support courses are appropriate for a geology major. Our observation is that we are within national norms. While additional required courses in mathematics, chemistry, and physics are desirable, the courses in question are five credit hour courses, which consume an inordinate amount of the 120 limit on total credit hours.

Thus, we continue our practice of requiring only one semester of Calculus, General Chemistry, and Physics for our graduates, but we have done a more thorough job of explaining to our students that additional courses in these disciplines are required for

graduate school. We have also added the second-semester courses for these disciplines (CHEM 132/132L, PHYS 132/132L, and MATH 152) to the options for restricted electives for Geology majors. This enables students who are interested in attending graduate school to include these additional courses as part of their normal degree program.

Issue 5—The use of temporary full-time faculty disrupts academic continuity and challenges content quality, and should not exceed 15% of program instruction (national best practices are 10-20%)

2007 response—Geology has five tenured faculty members, who primarily teach courses for majors, and three full-time temporary instructors, who primarily teach general education courses for non-majors. We agree that it would be more desirable to have one or more tenure-track professors in these temporary positions. In particular, this would give us the ability to have more 100-level sections taught by the permanent faculty.

Result—There has been no change. We currently have five tenured faculty members, two full-time temporary instructors teaching only general education courses, and two part-time instructors who also teach general education courses.

Physics

Issue 1—There is too great a use of temporary full-time faculty members. The use of temporary full-time faculty disrupts academic continuity and challenges content quality, and should not exceed 15% of program instruction (national best practices are 10-20%).

2007 response—Physics has three tenured or tenure-track professors and one full-time temporary instructor. We are pleased to have Dr. Alex Gurshtein, the full-time temporary instructor, teaching eight sections of PHYS 100 and PHYS 101 each year. However, we anticipate that he will retire in a few years. We agree that the best outcome for the program following Dr. Gurshtein's retirement will be to recruit a tenure-track professor to replace him.

Result—Dr. Gurshtein retired in 2010 and his position was filled with another full-time temporary person. A fourth tenure track physicist was hired in 2011. However, with continued growth in demand for physics courses required by other programs, we do still need the full-time temporary position.

Issue 2—Without a dedicated classroom and preparation area, important demonstrations are not presented at appropriate junctures in the curriculum.

2007 response—We agree.

Result—In the years immediately following the last program review, we did attempt to schedule courses involving demonstrations into classrooms in Wubben Hall. Scheduling physics lectures into rooms conducive to demonstrations has become increasingly

difficult because of limitations on room availability due to CMU enrollment growth. Many of our introductory classes are now taught in various buildings across campus. This complicates the logistics of using demonstrations.

Issue 3—More physics majors can be accommodated with existing resources.

2007 response—We agree.

Result—We have participated in college sponsored marketing. We now have a physics web site and continue to do outreach to area schools, especially through our Society of Physics Students club. The number of physics majors has increased by 29% from 2007-08 (thirty-eight majors) to 2011-12 (forty-nine majors).

Issues common to chemistry, physics, and geology

Issue 1—Low salaries may be affecting the ability of programs to attract and retain qualified faculty members.

2007 response—We agree that salaries should be higher. Salaries for incoming tenure track professors have increased in recent years and now appear to be reasonably competitive. In our two most recent recruitment efforts (2006 and 2007), we successfully hired our top two candidates in physics and our top candidate in chemistry. We should now focus on ensuring a reasonable progression in salary (at all levels) as professors become more experienced and accomplished.

Result—The science faculty has benefited from the campus-wide salary increases that took place several years ago. In spite of the recession and tight university budgets, the faculty has continued to receive cost-of-living increases each year. Nearly all of our recruitments have resulted in the hiring of our top-rated candidate.

Issue 2—Assessment activities require more diligent follow-up, analysis of data, and implementation of indicated changes.

2007 response—We agree.

Result—The faculty has not collected and analyzed data to the extent that was planned. The department head accepts a measure of responsibility for this. Assessment plans will be re-done in 2013 based on the new student learning objectives identified in 2012. The department head will ensure that responsibilities are explicitly assigned to specific people, and will hold people accountable for their responsibilities on their annual performance reviews.

Issue 3—Funding to support undergraduate research activities is generally limited.

2007 response—In recent years we have received major grants supporting undergraduate research from the National Science Foundation and the U.S. Geological Survey. Given how competitive and time-consuming these efforts are, we are proud of our success.

Result—New tenure-track hires since 2007 have all received $5,000 in startup money. Chemistry faculty applied twice for National Science Foundation Major Research Instrumentation grants to buy a gas chromatograph-mass spectrometer but were unsuccessful. Reviewer comments indicated that having three faculty members using the instrument was too few to be competitive. Fortunately, a local scientist made a donation that allowed us to purchase a used version of this instrument. The geology faculty has received $196,170 for research from the National Science Foundation, Department of Energy, and a University of Colorado research consortium.

Issue 4—Program graduate acceptance rates into graduate programs is barely at, or below, the national average.

2007 response—Our experience is that nearly all of our students with a genuine interest in graduate studies are admitted to graduate school.

Result—Nine out of the forty-six geology graduates since the last program review in 2006 applied for and entered graduate school; six have received their graduate degrees. Six out of sixteen chemistry majors applied for graduate school and five entered. Five out of nineteen physics graduates applied for and entered graduate school.

Issue 5—Students enrolled in physical science programs indicated conflicts between required courses in physical science and mathematics.

2007 response—We probably do not have the ability to eliminate all possible conflicts without extending our hours into the evening. There are several factors that contribute to this situation, such as time-consuming lab sections, staffing limitations (time and area of expertise), and students taking courses in an atypical sequence.

Result—We believe that we have improved our scheduling, although problems have still occurred based on the usual factors plus, in some years, construction-driven limitations on room availability. Students let us know about their conflicts each semester before registration. We note those conflicts, fix them when possible, and strive to avoid them in later semesters.

B. Curriculum

1. Program curriculum

In addition to major requirements, each BS program of study includes general education courses, other lower division requirements, and electives. Program sheets for each of the degrees, certificates, and minors are provided in Appendix I.

Chemistry

The CMU chemistry curriculum is a classical curriculum patterned after the ACS Guidelines for Bachelor's Degree Programs. It is intended to provide both a broad background in chemical principles and in-depth study of chemistry and chemistry-related areas that build on this background. The curriculum is organized into three categories: *foundation courses*, including physics and calculus, provide the fundamental tools necessary for a physical science student, *core courses* use those tools to provide breadth within the specific discipline of chemistry, and rigorous *restricted elective courses* provide additional breadth and depth. Because chemistry is an experimental science, substantial laboratory work is a significant part of these experiences. The curriculum also includes experiences that develop skills essential for students' effective performance as scientific professionals.

The general chemistry sequence provides a common background for students with a wide range of high school experiences. It often acts as a maturation period for students, both in chemical topics and in mathematical and laboratory skills. The purpose of introductory chemistry course work for students pursuing a degree in chemistry is preparation for the additional core courses. This introduction ensures that students know basic chemical concepts such as stoichiometry, states of matter, atomic structure, molecular structure and bonding, thermodynamics, equilibria, and kinetics. Students are taught to be competent in basic laboratory skills such as keeping a notebook and report writing, safe practices, use of electronic balances and volumetric glassware, preparation of solutions, chemical measurements using electrodes and spectrophotometers, and data analysis.

The other core courses include instruction in three fundamental areas of chemistry: analytical chemistry, organic chemistry, and physical chemistry. This coursework builds on the introductory chemistry experience, provides breadth, and lays the groundwork for in-depth course work in these and other areas. At the successful conclusion of each core course, students will have mastered the vocabulary, concepts, and skills required to pursue in-depth study in that area.

The restricted elective courses build on the core courses. They provide further breadth and in-depth instruction in a variety of chemistry areas. They integrate topics introduced in the foundation courses and investigate these and other topics more thoroughly. Exams and assignments typically require more critical thinking and problem-solving skills.

Throughout the curriculum, students have significant laboratory experiences. The laboratory experience includes synthesis of molecules, measurement of chemical properties, structures, and

phenomena, hands-on experience with modern instrumentation, and computational data analysis. Students are instructed in the operation and theory of modern instruments and use them to solve chemical problems. Additionally, many students participate in research under faculty guidance.

Geology

The geology curriculum is comparable to the curricula of other schools across the U.S. that offer a B.S. degree in Geology. In addition to CMU's general education requirements, the geology, environmental geology, and geology secondary education BS curricula all require foundation courses in math and other sciences. The foundation courses include general chemistry, basics physics, probability and statistics and calculus. Additionally, students are required to either take biology or continue with a second semester of chemistry or physics. The core geology courses include four lower-division geology courses: physical and historical geology, field studies, and computer applications. Six upper-division geology classes are also included in the geology core: structural, crystallography and mineralogy, geomorphology, stratigraphy and sedimentation, summer field camp and senior seminar.

Beyond the geology core courses, the three majors diverge. The geology major requires petrology and geophysics, while the environmental geology major requires environmental geology, hydrology and ground water. The geology teacher licensure major does not require further geology courses because the students must take several education courses.

The geology and environmental geology programs require that students take nine credit hours of classes from a list of restricted electives. The selected electives were designed to allow students to either focus their studies more deeply into an area of interest, or to take additional math, chemistry or physics if they are planning to apply to graduate school.

The structure of the degree programs with foundation courses, core geology courses and restricted electives provide students with a strong and broad foundation in science and math, as well as an ability to focus their studies more deeply into a particular area of interest in geology or environmental geology.

Physics

The CMU physics curriculum is similar to that found in most baccalaureate physics programs in the U.S. For physics majors it provides a background for pursuing graduate study in physics and related fields. It also provides a background for physics majors interested in pursuing careers in a variety of scientific and technical fields. In addition, there are several introductory courses that satisfy diverse needs of science and non-science students.

The six freshman-level courses provide an introduction to physics for a variety of audiences: PHYS 100 and 101 are introductory courses for non-science majors. PHYS 111/112 are algebra-based general physics courses required for biology majors and construction management majors. The PHYS 131/132 sequence is calculus-based physics for physics, engineering and other science majors. All of these introductory courses also fulfill the college requirement for general education science courses.

The curriculum for physics majors provides a foundation in the four main areas of physics: classical mechanics, electricity/magnetism/optics, quantum mechanics, and statistical/thermal physics. It also provides a strong foundation in mathematics; there are five required mathematics courses for the major. The curriculum includes three laboratory classes beyond the freshman level: one electronics lab class, a sophomore lab and a junior lab. These give students a foundation in various areas of experimental physics, error analysis, and report writing.

The physics curriculum also includes several more specialized courses, such as topics courses offered in areas of interest to the faculty and specialized courses like solid state physics. All students are required to do a senior research project under the supervision of a physics faculty member. They are also required to give two public fifty-minute physics seminars.

2. Program currency

Chemistry

The chemistry program made significant changes to the chemistry concentration in December 2012. The changes were brought about by addition of two new tenure-track faculty members: an inorganic chemist starting in fall 2011 and a biochemist starting in fall 2012. The changes to the curriculum include additional required courses: Inorganic Chemistry, Instrumental Analysis with lab, and a one-credit course Communication in the World of Chemistry that students will take along with Advanced Lab. The inorganic chemistry requirement will give students experience in the one major area of chemistry not well-represented before 2011. The instrumental analysis requirement will give students valuable additional experience in analytical chemistry and aid those who wish to stay in Western Colorado find employment. The communication course will give students additional experience writing, speaking, and doing literature work related to their advanced laboratory course. Additional courses in inorganic chemistry, biochemistry, and environmental chemistry have been added to the list of restricted electives. All of these changes bring the curriculum closer to alignment with American Chemical Society guidelines for undergraduate chemistry programs.

The chemistry minor was also changed from requiring General Chemistry, Organic Chemistry, and Quantitative Analysis to requiring General Chemistry, Organic Chemistry I, and nine additional chemistry credits. This change to the minor will allow students more flexibility in tailoring the minor to their specific needs. Students taking the courses required for the current minor will still be able to get a minor under the new requirements, but more students taking a variety of upper-division chemistry courses will now be eligible. All of these changes were approved in the December 2012 meeting of the CMU curriculum committee and will be implemented in fall 2013.

Geology

Geology courses are updated and expanded as new developments in the earth sciences emerge in the literature. Faculty members also use their personal research to enhance the subject matter they teach; thus, what is presented to the students is current.

Physics

Recent changes to the physics curriculum include a new course, PHYS 230 Intermediate Dynamics. A topics course is offered in most years. These courses are selected based on faculty expertise and cover new developments in physics. Recent topics courses include: Low Temperature Physics, General Relativity, Quantum Optics, and Middle School Physics. PHYS 482 Senior Research has been modified to make the course more structured to promote student success. Students have a group meeting each week to discuss progress, and several progress reports are required during the semester.

3. Program delivery

On-campus traditional delivery is the norm in chemistry, geology, and physics. A small number of courses are also taught at the Montrose campus and in high schools. We recently began offering a few general education courses on-line.

Chemistry

All chemistry courses are delivered in a traditional classroom and lab setting on the CMU main campus. Two courses have been taught in other venues. CHEM 100 Chemistry and Society has been delivered on-line eight times since 2009, and has been taught in a traditional setting every spring semester since 2009 by a part-time instructor at the CMU campus in Montrose. CHEM 121, 121L Principles of Chemistry has been taught by high school teachers with CMU approval and oversight at Ridgway High School (four times) and Telluride High School (three times) as part of the Early Scholars program.

Geology

All geology courses are delivered in a traditional classroom and lab setting on the CMU main campus. GEOL 100 Survey of Earth Science has been taught on-line twice since 2011 and is taught every year by a part-time instructor at the CMU Montrose campus. GEOL 107 Natural Hazards and Environmental Geology has been taught on-line six times since 2011. GEOL 111, 111L Introduction to Physical Geology has been taught every fall semester since 2010 by a part-time instructor at the CMU Montrose campus. GEOL 105 Geology of Colorado was added to the on-line offerings in the fall 2012 semester.

Physics

All physics courses are delivered in a traditional classroom and lab setting on the CMU main campus. Two courses have been taught elsewhere, as well. PHYS 100 Concepts of Physics is taught every fall semester by a part-time instructor in a traditional setting at the CMU Montrose campus. PHYS 100 and PHYS 101 Elementary Astronomy have been taught by a high school teacher with CMU approval and oversight at Nucla High School; PHYS 100 twice and PHYS 101 three times.

C. Analysis of Student Demand and Success

1. Enrollment, credit hours, and graduates

The numbers presented here cover the period from academic year 2008 (the 2007-2008 school year, or AY08) through academic year 2012 (the 2011-2012 school year, or AY12). The figures for enrollment in each major count all students who have declared that major, including those for whom this would be a second major. Figures for enrollment in courses and student credit hours are based on the number of students enrolled in each course at the end of the semester. Program-specific tables are shown below. More detailed tables are provided in Appendix II.

For context, the total enrollment at CMU increased by 45%, from 6,199 in fall 2007 to 9,005 in fall 2011. (Spring semester enrollments were ~5% lower than fall in both years.) The total number of credit hours generated at CMU increased by 44%, from 152,964 in AY08 to 220,530 in AY12.

The B.S. in Physical Sciences experienced increases that exceed those for the university as a whole. Enrollment in majors (B.S., A.S., and certificates) increased by 63% from AY08 to AY12 (from 158 to 258). During that same time period, enrollment in courses increased by 64% (from 3,373 to 5,523) and student credit hours increased by 65% (from 8,746 to 14,468). The number of minors increased, but only by 25% (from 39 to 49). The annual number of graduates from the B.S. in Physical Sciences stayed in the range of twelve to thirteen except for AY11, when graduates spiked to twenty. The total annual number of graduates from the geology and physics emphases in the A.S in Liberal Arts stayed in the range of two to four. The total annual number of students completing a minor varied fluctuated between eleven and fourteen during this five-year period.

Chemistry

Chemistry experienced a 35% increase in the number of majors, from fifty-one in AY08 to sixty-nine in AY12 (Table 3). Sixteen majors graduated during this period, for an average of 3.2 per year. The number of graduates was 3, 0, 5, 4, and 4 for AY08 through AY12, respectively. Given the increase in number of majors from AY08 to AY12, we expect to see an increase in graduates in the years beyond AY12 as these new majors finish their degrees. The number of students declaring a minor in chemistry varied from fourteen to twenty-four over the reporting period. Twenty-seven students completed the minor for an average of 5.4 per year.

Course enrollments and student credit hours increased by 71% and 73% to 1,625 for enrollment and 4,253 for credit hours (Table 4). In an average year, 81% of the enrollment in chemistry occurs in 100-level courses. Most of this enrollment comes from other degree programs that require their majors to complete chemistry courses at this level. Another 17% of chemistry enrollment occurs in 300-level courses, including Organic Chemistry and Biochemistry, which are well-enrolled because of their importance to students preparing for medical school. In the future, we expect to see enrollment in chemistry courses track with changes in enrollment at CMU overall and in programs that require chemistry. We expect to see 300-level and 400-level enrollments grow because a recent increase in staff gives us the ability to offer additional

Table 3. Summary of Majors and Graduates by Degree Program.

Degree Program		Number of Students Declared				Annual Number of Graduates			
		Annual Average[1]	AY08	AY12	Percent Change AY08 to AY12	Low	High	Total	Average
BS	Chemistry	59	51	69	+35	0	5	16	3.2
Minor	Chemistry	19	18	18	0	4	9	27	5.4
Prov Bacc[2]	Chemistry	1.5	0	2	-	-	-	-	-
BS	Geology	52	37	64	+73	2	12	28	5.6
BS	Geology, Environmental	16	12	25	+108	1	2	7	1.4
BS	Geology, Pre-Teacher Ed	<1	0	2		0	0	0	0
BS	Geology, Teacher Cert	2.4	1	2	+100	0	0	0	0
AS	Liberal Arts, Geology	24	14	33	+136	1	4	10	2.0
Minor	Geology	2.2	1	4	+300	0	0	0	0
Prov Bacc[2]	Geology	4	0	6	-	-	-	-	-
Certificate	GIST	6.4	5	6	+20	2	10	23	4.6
Minor	GIST	8.2	8	9	+13	1	5	14	2.8
Minor	Watershed Science	8.0	8	11	+38	2	4	15	3.0
BS	Physics	32	25	33	+32	2	5	19	3.8
BS	Physics, Teacher Cert[3]	1.0	5	0	-100	0	0	0	0
AS	Liberal Arts, Physics	12	8	16	+100	1	1	3	0.6
Minor	Physics	4.4	4	7	+75	1	2	5	1.0
Prov Bacc[2]	Physics	0	0	0	-	-	-	-	-

[1]Average over the five academic years from AY08 through AY12.
[2]Provisional baccalaureate status began in AY11.
[3]Degree discontinued in AY05.

Table 4. Summary of Chemistry Enrollment and Credit Hours by Level for AY08 through AY12.

Chemistry	Annual Average AY08 to AY12	AY08	AY12	Percent Change AY08 to AY12
Enrollment by student level				
Freshman	181	134	327	+144
Sophomore	325	234	425	+82
Junior	250	213	324	+52
Senior	416	344	531	+54
Non-degree	15	17	7	-59
Provisional	9	8	11	+38
Total	**1,196**	**950**	**1,625**	**+71**
Student credit hours by student level				
Freshman	464	348	826	+137
Sophomore	846	610	1,111	+82
Junior	656	545	856	+57
Senior	1,093	887	1,415	+60
Non-degree	38	44	17	-61
Provisional	22	20	28	+40
Total	**3,119**	**2,454**	**4,253**	**+73**
Enrollment by course level				
100	958	763	1,332	+75
200	30	24	39	+63
300	198	159	243	+53
400	10	4	11	+175
Total	**1,196**	**950**	**1,625**	**+71**
Student credit hours by course level				
100	2,522	1,984	3,505	+77
200	60	48	78	+63
300	511	411	636	+55
400	25	11	33	+200
Total	**3,119**	**2,454**	**4,253**	**+73**

courses at this level. For example, the anticipated addition of Biochemistry II will be attractive not only to chemistry majors but to biology majors as well.

Geology

The number of majors in the geology concentration increased by 73%, from thirty-seven in AY08 to sixty-four in AY12 (Table 3). Majors in the environmental geology concentration increased by 108%, from twelve in AY08 to twenty-five in AY12. From AY08 through AY12, there were twenty-eight graduates from the geology concentration and seven graduates from the environmental geology concentration, for an annual average of 5.6 and 1.4, respectively. Graduates by year from AY08 through AY12 showed considerable fluctuation: 4, 8, 2, 12, and 2 for geology. Graduates from environmental geology were more consistent: 2, 1, 1, 2, and 1. However, with the increased number of students declaring these majors in recent years, we do expect to see a corresponding increase in the number of graduates as those students complete their degrees in the years beyond AY12. The number of majors in the geology A.S. emphasis increased by 136%, from fourteen in AY08 to thirty-three in AY12. Ten students graduated with this degree. The numbers from AY08 to AY12 were 1, 4, 2, 1, and 2, respectively. The number of students declaring the geology minor increased from one in AY08 to four in AY12, averaging 2.2 per year. No students completed the minor during this time period.

We offer both a minor and a technical certificate in geographic information science and technology (GIST). The completion requirements are identical for both. The certificate provides an opportunity for students (such as working professionals already having a bachelor's degree) who do not want to complete a B.S. or B.A. at CMU; a minor can be awarded only to students completing a bachelor's degree. The number of students declaring their intent to complete the minor increased from eight in AY08 to nine in AY12 while the number declaring the certificate increased from five to six. Over this period, fourteen students have completed the minor and twenty-three have completed the certificate, for an annual average of 2.8 and 4.6, respectively. The GIST program is especially popular among students completing the geology degree and students completing the B.S. in Environmental Science.

Course requirements for the geology and environmental geology concentrations overlap, so they are combined for the purpose of examining course enrollments and student credit hours. Enrollments and credit hours increased by 68% and 74%, respectively, to AY12 totals of 2,609 for enrollment and 6,748 for credit hours (Table 5). In an average year, 88% of the enrollment in geology occurs in 100-level courses. That general education geology courses are well-enrolled should come as no surprise given that prominent local and regional geological features naturally generate curiosity about geology. Geology is also staffed at a level that permits the program to offer more general education course options than other science programs. Two full-time temporary faculty members that teach only 100-level courses generate 47% of geology's student credit hours.

We expect to see future geology enrollment track with changes in CMU enrollment. The geology faculty is currently formulating curriculum changes that would enhance our offerings in geotechnology and make graduates more appealing candidates for entry-level positions in industry. We anticipate that these changes will lead to additional enrollment growth.

Table 5. Summary of Geology Enrollment and Credit Hours by Level for AY08 through AY12.

Geology	Annual Average AY08 to AY12	AY08	AY12	Percent Change AY08 to AY12
Enrollment by student level				
Freshman	680	424	900	+112
Sophomore	658	509	882	+73
Junior	250	221	326	+48
Senior	389	371	490	+32
Non-degree	24	16	7	-56
Provisional	39	11	10	-9
Total	**2,008**	**1,552**	**2,609**	**+68**
Student credit hours by student level				
Freshman	1,868	1,151	2,478	+115
Sophomore	1,707	1,288	2,326	+81
Junior	627	540	812	+50
Senior	874	827	1,104	+33
Non-degree	63	44	25	-43
Provisional	16	25	3	-88
Total	**5,156**	**3,875**	**6,748**	**+74**
Enrollment by course level				
100	1,693	1,254	2,214	+77
200	43	45	53	+18
300	163	170	192	+13
400	110	83	151	+82
Total	**2,008**	**1,552**	**2,610**	**+68**
Student credit hours by course level				
100	4,517	3,274	5,930	+81
200	128	135	159	+18
300	295	313	360	+15
400	216	153	302	+97
Total	**5,156**	**3,875**	**6,751**	**+74**

Physics

The number of majors in the physics B.S. concentration increased by 32%, from 25 in AY08 to 33 in AY12 (Table 3). Nineteen majors graduated during this period for an average of 3.8 per year. The number of graduates varied over the review period; graduates for AY08 through AY12 were 3, 4, 5, 2, and 5, respectively. We do expect to see an increase in graduates as the increased number of students declaring a physics major in recent years complete their degrees in the years beyond AY12. The number of majors in the physics A.S. emphasis increased by 100%, from 8 to 16. However, few of these students have completed the A.S. degree; the number of graduates were 1, 0, 0, 1, and 1 for the five year review period.

Course enrollments and student credit hours increased by 48% and 43%, respectively, to 1,288 for enrollment and 3,464 for credit hours (Table 6). In an average year, 91% of the credit hours generated by physics occur in the 100-level courses. Most of this enrollment originates from other degree programs that require their students to complete physics courses at this level. Recent new degree programs in Mechanical Engineering are a major source of the increase in 100-level enrollment. In the future, we expect to see physics enrollment track with CMU enrollment, and with enrollment in those programs that require physics.

The physics program recently accepted an invitation from the Air Force Academy to become part of the Falcon Telescope Network. The Academy is providing a telescope and dome (with a total value of well over $100,000) to each of several colleges and universities in Colorado, Pennsylvania, and Chile. Each host institution must supply electricity, internet access, and a small building to house the equipment. The telescopes will be linked in an on-line network, with all telescopes accessible to each institution. Users will input observation requests from a computer at their campus, then download images the next day. As the network is implemented, CMU will incorporate more opportunities in astronomy into its curriculum, projects, and outreach efforts. Given the inherent appeal of astronomy, this capability may contribute to an increase in enrollment and majors.

Table 6. Summary of Physics Enrollment and Credit Hours by Level for AY08 through AY12.

Physics	Annual Average AY08 to AY12	AY08	AY12	Percent Change AY08 to AY12
Enrollment by student level				
Freshman	265	181	290	+60
Sophomore	330	246	397	+61
Junior	197	118	279	+136
Senior	312	310	311	0
Non-degree	17	12	9	-25
Provisional	6	4	2	-50
Total	**1,126**	**871**	**1,288**	**+48**
Student credit hours by student level				
Freshman	759	533	818	+53
Sophomore	911	697	1,079	+55
Junior	530	324	739	+128
Senior	803	818	801	-2
Non-degree	47	34	22	-35
Provisional	14	11	5	-55
Total	**3,065**	**2,417**	**3,464**	**+43**
Enrollment by course level				
100	1,029	792	1,191	+50
200	29	22	25	+14
300	39	37	44	+19
400	29	20	28	+40
Total	**1,126**	**871**	**1,288**	**+48**
Student credit hours by course level				
100	2,822	2,208	3,217	+46
200	85	63	75	+19
300	111	106	124	+17
400	47	40	48	+20
Total	**3,065**	**2,417**	**3,464**	**+43**

2. Student retention

Snapshots of student retention referenced to the fall 2011 semester are presented in Table 7. Numbers and percents are reported for students continuing with or graduating from each major relative to those who were present in fall 2010 (a one-year snapshot) and those who were present in fall 2007 (a four-year snapshot).

Looking first at the one-year snapshot and combining students retained in the major with graduates, the B.S. programs retained 60% in chemistry, 78% in geology, 69% in environmental geology, and 61% in physics. The A.S. programs in geology and physics retained 38% and 57%, respectively. Taking the same approach to the four-year snapshot, the B.S. programs retained 32% in chemistry, 53% in geology, 64% in environmental geology, and 50% in physics. In the four-year snapshot the A.S. programs in geology and physics retained 30% and 0%, respectively. These results need to be interpreted with a degree of caution. There is a fair amount of fluctuation in the numbers of majors and graduates from one year to another, thus snapshots relative to other years in the period covered by this review may look different.

Retention in our physical sciences degree is problematic. We observe that among the students declaring a major in these programs are some who were not strongly science-oriented in high school. These incoming students tend to be weaker in math and science and experience more difficulty passing courses. We do recognize the diversity in preparation among our students and strive to bring these students up to speed without slowing the pace down to the point that we bore the better-prepared students. We meet with students outside of class to answer questions, develop mentoring relationships, strive to make classes engaging and discuss career opportunities in our disciplines, and encourage students to use the Tutorial Learning Center. We will continue to identify more ways to increase retention.

Table 7. One-Year and Four-Year Snapshots of Retention

Degree Program	Fall 2011 Status of Students Enrolled in Fall 2010				Fall 2011 Status of Students Enrolled in Fall 2007			
	Retained in Major		Graduated		Retained in Major		Graduated	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
BS Chemistry	28	56	2	4	2	6	9	26
BS Geology	24	55	10	23	0	0	16	53
BS Env. Geology	9	69	0	0	0	0	7	64
AS Geology	5	38	0	0	0	0	3	30
BS Physics	15	54	2	7	4	18	11	50
AS Physics	4	57	0	0	0	0	0	0

3. Student successes and recognition

Graduates from chemistry, geology, and physics have been successful in finding employment in their discipline or being admitted to graduate school. Nearly all take part in senior research or participate in faculty research projects. Many have given presentations at professional meetings and at the annual CMU Student Showcase. Several have been coauthors on publications.

Chemistry

Of our sixteen graduates over the past five years, three have applied to graduate school and three have applied to pharmacy school. All three pharmacy school applicants were accepted and two of the three graduate school applicants were accepted. Eight graduates have reported employment in chemistry or a closely related field. The rest did not have an employment offer as of graduation and have not reported back on the outcome of their employment searches.

Four students will be presenting posters at the 245th American Chemical Society National Meeting taking place in April 2013. These students successfully applied to the CMU Associated Student Government for the funds to pay for this trip. Overall, eight of our students contributed to these presentations and a presentation by a chemistry faculty member at this meeting. Additionally, a research student of Dr. D'Andrea gave a poster presentation at the 2012 CMU Student Showcase.

Geology

Nine out of the forty-six geology graduates since 2006 applied for graduate school; all were successful. Six of these students have received graduate degrees in geology. Twenty-five graduates obtained jobs in the geosciences. Employers include state and federal agencies, mining companies, petroleum companies, oil-and-gas service companies, and geotechnical consulting.

Sixty-four student researchers gave sixty-one presentations. Venues included meetings of the Geological Society of America, the American Association of Petroleum Geologists, the Upper Colorado River Basin Forum, and the Grand Junction Geological Society. Five recent graduates gave presentations at a meeting of a research consortium at the University of Colorado-Boulder.

A student was awarded the prestigious campus-wide Aspinall Scholarship two years in a row. Seven students received the Neal J. Harr Memorial Outstanding Geology Student Award given by the Rocky Mountain Association of Geologists in Denver. Ten women students have received the Outstanding Geoscience Student Award given by the Association of Women Geoscientists Laramie Chapter since 2003. Eight students were awarded the Best Oral or Poster Presentation in the Sciences at the annual CMU Student Showcase. Twenty-seven students have been awarded scholarships, including the Scholes Memorial Scholarship, the GITA-Geospatial Scholarship from the Rocky Mountain Geographic Information and Technology Association, the Roadifer Scholarship, the Western Slope Oil and Gas Association Scholarship, the Grand Junction Geological Society Field Camp Scholarship, and the Grand Junction Gem and Mineral Club Scholarship.

Physics

Five of our nineteen graduates over the last five years were accepted to graduate school. Six graduates are known to have found employment in physics or a related field. Positions include research assistant at a Department of Energy national laboratory, petroleum engineer, water engineer, engineer, and middle school math teacher. Three students have had papers published in refereed journals since the last program review. A student received a Chambliss Astronomy Student Achievement award for her poster at the 220th American Astronomical Society meeting in Anchorage Alaska in 2012. Another student won the 2011 award for Outstanding Performance in Physics at the Los Alamos National Lab Student Symposium. Best Presentation by an Undergraduate Student was awarded to one of our students at the annual American Physical Society Four Corners Section Meeting in 2009. Still another student won an award for Best Oral Presentation at the 2011 Mesa State College Student Showcase.

D. Program Resources

1. Faculty

Faculty headcount and rank—Chemistry, geology, and physics collectively had seventeen full-time faculty in AY12, with thirteen (76%) being tenured or on tenure-track (Table 8). Full-time faculty numbers have been stable since AY08, with only one resignation. Chemistry and physics each gained one tenure-track position during this period. (Chemistry has an additional tenure-track position that started in fall 2012.) Our full-time temporary instructors in chemistry and geology teach only 100-level courses; the full-time temporary instructor in physics occasionally teaches upper division courses as well. Chemistry has a full-time lab coordinator who by contract may teach up to three sections of lab each year.

A listing of full-time faculty present during the review period with dates of service is shown in Appendix III. Curriculum vitae are also provided in Appendix III.

Table 8. Composition of Faculty by Type for Academic Years 2008 and 2012.

	AY08				AY12			
	T[1]	TT[2]	FT-T[3]	Total	T[1]	TT[2]	FT-T[3]	Total
Chemistry	2	1	1	4	1	3	1	5
Geology	4	1	2	7	5	0	2	7
Physics	1	2	1	4	3	1	1	5
Total	7	4	4	15	9	4	4	17

[1]Tenured
[2]Tenure-track
[3]Full-time temporary

Faculty qualifications—All seventeen tenured and tenure-track professors have Ph.D.'s in their discipline. Two of our four full-time temporary instructors have Ph.D.'s; the other two have M.S. degrees. Seven of the nine part-time instructors employed in AY12 had master's degrees; the other two had B.S. degrees.

Credit hour generation—Full-time equivalent students (FTES) and full-time equivalent faculty (FTEF) are shown for each program for academic years 2008 and 2012 in Table 9. Both numbers have increased in all three programs. Full-time equivalent students increased faster than full-time equivalent faculty; the ratio of FTES to FTEF for individual programs increased between 25% and 44% depending on program, and the ratio for all three together increased by 32%. The ratio for AY12 ranges from twenty-one to twenty-five, with a ratio of twenty-three for all programs together.

A comparison of student credit hours generated by faculty type is presented in Table 10. The numbers for AY12 are included to emphasize current conditions; a year by year comparison is shown in Appendix II. In AY12, tenured and tenure-track faculty generated 62%, 44%, and 80% of the total student credit hours for chemistry, geology, and physics respectively. In addition to having one full-time temporary instructor, chemistry relies on part-time instructors for many of its lower-division labs, and sometimes for lecture courses. Geology has two full-

time temporary instructors who teach general education courses with high enrollments, hence the high percentage (47%) of student credit hours generated by this faculty type. Physics has one full-time temporary instructor, and in most years relatively little need for part-time instructors.

Table 9. Full-time Equivalent Students and Faculty for Academic Years 2008 and 2012.

	AY08			AY12			Percent Change in FTES:FTEF from AY08 to AY12
	FTES[1]	FTEF[2]	FTES:FTEF[3]	FTES[1]	FTEF[2]	FTES:FTEF[3]	
Chemistry	81.8	4.2	19.6	141.8	5.6	25.4	+30
Geology	129.4	7.8	16.5	225.8	9.5	23.8	+44
Physics	80.6	4.8	16.7	115.5	5.5	20.8	+25
Total	291.8	16.8	17.4	483.1	20.6	23.5	+35

[1]Full-time equivalent students
[2]Full-time equivalent faculty
[3]Ratio of FTES to FTEF

Table 10. Percentage of Credit Hours Generated by Each Type of Faculty.

	Annual Percent of Credit Hours by Faculty Type			
	Low	High	Average	AY12
Chemistry				
Tenured/Tenure Track	50	63	57	62
Full-Time Non-Tenure Track	17	46	33	17
Part-Time	4	20	9	20
Geology				
Tenured/Tenure Track	36	44	39	44
Full-Time Non-Tenure Track	47	58	53	47
Part-Time	5	9	8	9
Physics				
Tenured/Tenure Track	47	80	57	80
Full-Time Non-Tenure Track	19	46	33	19
Part-Time	2	33	11	2
Overall				
Tenured/Tenure Track	48	63	54	63
Full-Time Non-Tenure Track	26	43	36	26
Part-Time	4	16	10	11

There is significant fluctuation in credit hours by faculty type from year to year. Sabbatical leaves are an important factor in this fluctuation. For example, we hired a full-time non-tenure track person to fill in for a chemistry professor on a full-year sabbatical, which increased the proportion of chemistry courses taught by this faculty type for just that year. One-semester sabbatical leaves in physics and geology were covered using part-time faculty, thus increasing the proportion of credit hours generated by that faculty type in those particular years.

Successes and recognitions—Two professors have received the CMU Distinguished Faculty Award in Teaching: Dr. Johnson (geology) in 2003 and Dr. Richards (chemistry) in 2004. Two professors have received the CMU Distinguished Faculty Award in Scholarship: Dr. Aslan (geology) in 2003 and Dr. Cole (geology) in 2006.

Chemistry

Dr. Weinberg was the first author of a review article in Chemical Reviews and published a paper in Chemical Communications in 2011. On VIPER, the Virtual Inorganic Pedagogical Electronic Resource, Dr. Weinberg published two learning objects and submitted another for publication within the past year. Dr. Richards published a paper in the Journal of Chemical Ecology in 2008. Several presentations have been given by the chemistry faculty over the past few years in local venues, such as the CMU Faculty Colloquium, CMU Physics Seminar, and the Mesa County Summer Library Series. Chemistry faculty members will continue to give scientific presentations. For instance, Dr. Weinberg will be an invited speaker at the 2013 ACS National Meeting in New Orleans, LA for the ACS Award in Pure Chemistry: Symposium in Honor of Theodor Agapie.

The chemistry department has been active in community outreach throughout the past few years. Dr. D'Andrea and Dr. Weinberg are the faculty advisors of the Chemistry Club at CMU and have participated in public events in Grand Junction. The Chemistry Club held a family night at the Math and Science Center where CMU undergraduates performed exciting demonstrations in order to convey basic concepts of chemistry and science to children of various ages. In 2012 Dr. Weinberg also gave a presentation, "Energy: It's What Moves You!", at the Mesa County library as part of the Summer Library Science Series. Dr. Ayers and a CMU student performed demonstrations at Plateau Valley High School in December 2008.

Geology

The geology faculty has been highly productive both in and out of the classroom. Since the last program review in 2006 they have published at least twenty-five peer-reviewed papers and fifty abstracts and given at least twenty-five presentations at meetings of the Geological Society of America and American Association of Petroleum Geologists. Dr. Cole (with a co-author from CU-Boulder) received the A.I. Levorsen Award for best oral presentation at the 2008 Rocky Mountain Section Meeting of the American Association of Petroleum Geologists.

Physics

The Physics Program has been fortunate to attract quality faculty that are committed to excellence in teaching. Our faculty has a diverse range of professional backgrounds: computational astrophysics, experimental low temperature physics, quantum information theory, and general relativity theory. This allows us to deliver a wide range of course and research options for our students.

Physics faculty members have published numerous papers in refereed journals since the last program review. Dr. Middleton had three refereed publications and Dr. Collins had three. Dr. Workman had two since joining the program in 2011, and Dr. Shiekh has had two since joining us in 2010. Each faculty member regularly contributes a talk to the CMU Physics Seminar series and has presented regularly at regional and national physics/astrophysics conferences. The program has sponsored two regional Society of Physics Students (SPS) conferences. The CMU SPS chapter has won four Outstanding Chapter awards.

Advising—Students who decide to major in chemistry, geology, or physics contact the administrative assistant in the Department of Physical and Environmental Sciences, who enters their choice into the campus-wide data base and assigns them to a tenured or tenure-track professor in their discipline for advising. We accommodate student requests for a specific advisor provided that the individual is not overloaded with advisees. Otherwise, the administrative assistant makes assignments so as to keep the advising loads roughly equal. Our professors each advise roughly fifteen to thirty students, depending on the discipline and year. Students are not required to see an advisor, but the majority of our active majors do.

Measures of teaching effectiveness—Most of the faculty members have students fill out semester-end evaluations in all of their classes. Our campus-wide survey form includes twelve positive statements, such as: "The teaching methods/techniques used by the professor are effective"; "The exams and assignments are consistent with course content"; and "The course is appropriately challenging" (Appendix IV). Students assign a rating to each statement ranging from "1–strongly disagree" to "5-strongly agree". A median response is determined for each statement, and a single overall median of medians is calculated for all twelve statements. More recently, an overall average response has also been provided.

The tenured and tenure-track professors in chemistry, geology, and physics receive mostly 5's as the median of medians for their courses, with averages ranging from about 4.25 to 4.75. Several professors routinely receive 5's for all of their courses. Most of our full-time temporary instructors receive 4's as the median of medians, with averages typically ranging from about 3.75 to 4.25. Our part-time instructors tend to receive numbers similar to the full-time temporary instructors. However, some full-time temporary and part-time instructors score as well as the tenured and tenure-track professors on these evaluations.

2. Financial information

Internal funding—The department head submits a budget request to the administration each January for the upcoming fiscal year, which begins on July 1. Inasmuch as it has been many years since we have had to endure budget cuts, our working assumption is that we will receive the same amount as in the preceding year. Requests for one-time funds or base-building increases are approved based on justification and availability of funds.

Geology receives additional funding by way of a $30 fee that is attached to lecture courses involving a field trip and all lab courses. Chemistry and physics also collected lab fees through AY11. As part of a new effort to provide students with a simpler number for total tuition and fees, lab fees are no longer collected for these programs. Instead, the administration allocates an amount to each program that would have been collected as fees based on enrollment in the preceding year.

Table 11 shows costs for each program in AY12. Hourly compensation is for student assistants. Other current expenses include supplies, software, equipment purchase and repair, copier lease,

Table 11. Expenditures in Academic Year 2012.

	Chemistry	Geology	Physics	Total
Expenditure of Budget Allocation				
Contract Regular Wages	264,513	344,332	237,460	846,305
Contract Part-Time Wages	54,298	112,184	41,344	207,825
Contract Benefits	90,227	94,496	76,982	261,705
Hourly Compensation	1,182	2,304	0	3,486
Other Current Expenses	18,324	15,487	21,247	55,058
Travel	456	887	1,144	2,488
Internal Charges	2,805	3,234	1,994	8,033
Total	431,805	572,924	380,171	1,384,901
Expenditure of Course Fees				
Hourly Compensation	0	3,973	0	3,973
Other Current Expenses	15,990	17,347	2,535	35,872
Travel	0	32,522	0	32,522
Total	15,990	53,843	2,535	72,368
Total Expenditure	447,795	626,767	382,706	1,457,268
Student Credit Hours Generated	4,253	6,748	3,464	14,465
Dollars per Credit Hour	$105	$93	$110	$101

and similar costs. Travel costs in the budget allocation category refer to faculty travel. Travel costs in the course fee category are for van rental for field work during lab periods and other field trips. Internal charges are for phones and phone calls. The total expenditure by the physical sciences program was $1,457,268, giving a cost per credit hour ratio of $101.

External funding—Members of the chemistry faculty have applied for external funding to support their research at CMU. Dr. Richards and former professor Dodson were awarded a $126,000 grant from the NSF in 2007 for a collaborative research project. In 2009 and 2010 Dr. D'Andrea and Dr. Ayers applied for a National Science Foundation (NSF) Major Research Instrumentation (MRI) grant and an MRI^2 grant, respectively, to purchase a gas chromatograph-mass spectrometer. Neither of these grants were awarded. However, $11,000 was recently received as a donation from a local scientist, Dr. Ken Kosanke, to purchase a used version of this instrument. Last year, Dr. Weinberg applied to the American Chemical Society for a Petroleum Research Fund Undergraduate Grant. He did not obtain this grant but will reapply. Dr. Weinberg is also be applying for an NSF grant for Facilitating Research at Primarily Undergraduate Institutions.

Members of the geology faculty have received considerable external funding. The largest grant, $362,000, was awarded by the National Science Foundation in 2005 for a Research Experience for Undergraduates program that was conducted here from 2005 through 2008. Dr. Aslan received $94,870 for research from the National Science Foundation. Dr. Cole received $32,387 for research from the U.S. Department of Energy through their Research Partnership to Secure Energy for America. Cole also received five research grants totaling $71,125 from an industrial-research consortium at the University of Colorado-Boulder.

ESRI, the company that creates the most widely used GIS software, has donated nearly $200,000 worth of Virtual Campus Courses and Evaluation Copies of ArcGIS to students in the geology and GIST programs. The Rocky Mountain Geospatial Information and Technology Association donated $4,650 in scholarships for GIST students. Approximately $150,000 has come from Bureau of Land Management (BLM) to pay students who work as GIST interns in the local BLM office.

3. Library assessment

The assessments prepared by the Tomlinson Library are shown in Appendix V along with periodical lists. Comments from each discipline are shown below.

Chemistry

The library is struggling to provide access to the resources we need. The American Chemical Society recently increased the cost for its subscription package for the core journals in chemistry by almost $12,000, with more increases likely in the next couple of years. In order to continue our subscription to this basic package, the library has been forced to cut back on other chemistry journals. It is unclear at this time how the expected future price increases will be covered. The chemistry faculty makes considerable use of other journals outside of this package, but must do so through interlibrary loan. SciFinder is a chemistry literature-search tool that the faculty would very much like to use, but we cannot afford.

Geology

Our library holdings and digital access need improvement in order to meet our needs. We do not have access to electronic versions of a number of journals that we use, especially those from Elsevier Publishing. Interlibrary loan is the most common means by which students and faculty obtain research references.

Physics

The collection of physics books is a good match for the needs of students and faculty, but we are not as well off with respect to journals. On the positive side we get a review journal that lets us have an affordable subscription to Physical Review's digital archive. This is the most important physics journal series and the archive has been a great asset. However, it has a blackout period of three years for current articles. An institutional subscription allowing access to current articles would cost several thousand dollars, which would be difficult to fund. Also in physics we have a very good electronic preprint server which offers preprints of most physics articles for free (but they are not the final, fully edited versions of the articles). We rely on interlibrary loan to access other journals.

4. Physical facilities

Lecture courses are distributed among all of the classroom buildings on campus. All classrooms have computers, network and internet access, DVD players, document cameras, data projectors, and projection screens. Laboratory work is conducted in the Science Lab Building and Wubben Hall, which are both part of the Wubben-Science Center. The labs were completed and occupied in 1997 and renovated in 2011. Each discipline has its own dedicated space for laboratories and storage.

Chemistry

The chemistry laboratory facilities are on the third floor of the Science Lab wing of Wubben-Science. Chemistry facilities include:

- Two 24-student labs for general chemistry, each with six two-person fume hoods
- One 24-student lab for organic chemistry with hood space for all students
- One 15-student lab for other courses with hood space for four students
- Two labs for faculty and student research, with space for 14 people
- An instrument room housing most of the department's analytical instrumentation
- A stockroom and prep room

Geology

The geology laboratory facilities are on the first floor of the Science Lab wing and new wing in Wubben-Science. These facilities include:

- One 24-student lab for physical and historical geology
- The 24-student Noble Energy Lab for upper division geology courses
- One 12-student lab for GIST courses and other computer-oriented work

- A 12-student work room and auxiliary computer lab
- The John Scoles X-Ray Diffraction and Petrography Lab
- A room for storage and lab prep
- Two storage rooms
- A 12-person multipurpose room used for lecture, seminar, and projects

Physics

The physics laboratory facilities are on the second floor of the Wubben wing of Wubben-Science. The facilities include:

- One 24-student lab for freshman physics
- One electronics lab
- One advanced physics lab
- Two small research labs
- A stockroom

5. Instructional resources

Both theory and experiment are essential components of any science curriculum, and experimental work requires specialized scientific equipment. The need for current, often expensive equipment may be strongest in chemistry, but is significant for physics and geology as well. With complex instruments come costs for operation and maintenance. For example, chemistry's nuclear magnetic resonance spectrometer requires about $12,000 per year in liquid helium and liquid nitrogen. The cost of bringing a service person from the manufacturer to campus for this and other instruments can easily go as high as $2,500 or more. We also have special needs in the area of computer technology. Courses in geographic information systems require computers and servers that are especially fast and have unusually large storage capacities, along with expensive software.

Chemistry

The general chemistry lab is outfitted with computers and interfaces for computerized data collection and analysis. The program is well equipped with standard glassware and other apparatus (e.g., balances, melting point apparatus) needed in general chemistry and organic chemistry courses. The program is also very well equipped with instrumentation that is used in quantitative analysis, instrumental analysis, advanced lab, and research. Holdings include:

- A 300-MHz Fourier transform nuclear magnetic resonance spectrometer with dual carbon and hydrogen probes
- An inductively-coupled plasma atomic emission spectrometer
- An atomic absorption spectrometer
- A high-pressure liquid chromatograph with UV-visible and fluorescence diode array detectors
- A spectrocolorimeter
- An ion chromatograph

- An x-ray fluorescence spectrometer
- A Fourier transform infrared spectrometer
- A gas chromatograph with a thermal conductivity detector
- A potentiostat with electrodes for running cyclic voltammograms and controlled potential electrolyses
- Two rotovaps and a rapidvap
- A supercritical CO_2 extraction apparatus

Additionally, the department is in the process of purchasing a used gas chromatograph-mass spectrometer. All chemistry majors have the opportunity to use any of these instruments.

Geology

Computer-oriented courses and labs use appropriate software, such as ArcGis, Petra, Corel Draw, and TOPO. The computer resources in the GIST lab include twelve fast, high-memory capacity computers for students and one for the instructor, one high-resolution plotter, one large light table, one color printer, and one color scanner. Participation in the ESRI statewide license agreement now allows for GIS software to be used in this lab and throughout campus. Room WS 152 also has X general-use computers. All computers are owned and maintained by the CMU IT group.

Equipment holdings in geology include:

- An x-ray diffractometer
- A proton-precession magnetometer
- A 12-channel refraction seismometer
- An electrical resistivity unit
- Three binocular polarizing microscopes
- Fifteen polarizing microscopes
- One survey-grade geographic positioning system (GPS) unit
- Fourteen mapping-grade GPS units
- Twelve recreational-grade GPS units
- An oil-bath diamond saw
- Two thin-section machines
- Two stream tables

Physics

The Program has a full complement of laboratory apparatus and experiments used in intermediate and advanced lab courses. Our current laboratory and computer facilities are adequate for our program. Specialized equipment includes:

- An optics table used for photon counting and interference experiments
- A wave tank for density wave/soliton experiments
- A plasma experiment
- A liquid nitrogen cryostat for superconductivity experiments

6. Efficiencies in program operations

We do strive for efficiency in our operations. For example, within each program, equipment is shared as needed among the different courses, labs, professors, and research projects. Many of the instructional labs are used for multiple courses. The ion chromatograph, inductively-coupled plasma atomic emission spectrometer, and x-ray fluorescence spectrometer housed in chemistry are shared with the environmental science program. Our chemistry lab coordinator is an instructor for up to three labs each year. Because of the campus-wide limitations on available classroom space due to enrollment increases and remodeling projects, we sometimes schedule lecture courses in our labs, and share space for this purpose with other programs.

E. Student Learning Outcomes and Assessments

1. Student learning outcomes

The physical sciences faculty identified the following three objectives as the focus of its 2007 program assessment plan:

1) Chemistry, geology, and physics students demonstrate a strong foundation in understanding their selected discipline.

2) Graduates will be successful in gaining either admittance to graduate school or employment related to their discipline.

3) Graduates will demonstrate critical thinking and effective communication skills.

Assessment activities over the last five years were based on these objectives. The results of assessment are described in Sections E.2 and E.3, below.

The CMU faculty engaged in a campus-wide reconsideration of student learning objectives in 2012 using the Degree Qualifications Profile developed by the Lumina Foundation as a guide. The Degree Profile organizes student learning outcomes (SLO's) into six areas of learning: specialized knowledge; broad, integrative knowledge; intellectual skills; applied learning; civic learning; and institution-specific areas of learning. The profile calls for SLO's specific to each degree level, with the understanding that baccalaureate graduates will also have attained the SLO's for associate-level graduates. The SLO's themselves are concise statements of the measurable competencies to be demonstrated by graduates and used as the basis for assessment. Campus-wide SLO's were drafted in spring 2012, then each program created SLO's specific to its own graduates. These program-specific SLO's are discussed further in Section E.4, below. Each course within each program was then linked to the program-specific SLO's applicable to the course. The physical science faculty will formulate a new assessment plan in 2013 based on these SLO's.

2. Assessment of student learning outcomes

The results of our assessment are positive. Students are performing well on exit exams and major field tests, being admitted to graduate school, finding jobs in their field, giving presentations, publishing papers, and receiving awards.

Chemistry

Several forms of assessment have been carried out since the previous program review. The results of these assessments are discussed below.

Major Field Tests—The chemistry program administers the Educational Testing Service (ETS) major field tests (MFTs) to seniors in their final semester before graduation. The ETS reports a percentile, derived from the national pool of test-takers, for each student's score in each of four chemistry sub-disciplines. For each sub-discipline, we calculated the median of the percentiles attained by those students who took the test in 2007, and the median of those students who took the test in 2009 through 2012. Results are shown in Table 12.

Table 12. Results of Major Field Achievement Tests in Chemistry.

Sub-discipline	2007 median of percentiles achieved by CMU chemistry seniors (6 students)	2009-2012 median of percentiles achieved by CMU chemistry seniors (11 students)
Physical	42	51
Organic	70	40
Inorganic	32	52
Analytical	38	63

The median percentile of the 2009-2012 cohort is above the national median in all categories except organic. The organic subscores for this most recent group reflect a one-year sabbatical by the tenured organic chemist in which a replacement was hired to teach the course for a year. For the first year of the program review period, organic students had substantially higher success on the exam. Student score medians were above the national average in all other categories reported for the more recent students and have shown improvement over the review period. The exam is administered to students as an exit exam and is not a part of their grade. They are not required to pass the exam to graduate. The results do not suggest any areas for improvement other than continuing to strive to offer course work regularly in analytical and inorganic chemistry and maintain strong organic and physical chemistry offerings, even when the full-time faculty in charge of the course is not available.

Graduate school—Of sixteen graduates in the past five years, three have applied to graduate school, and three have applied to pharmacy school. All three pharmacy school applicants were accepted, and two of the three graduate school applicants were accepted.

Employment in the field—Of the remaining students, eight out of eleven have reported employment in chemistry or a closely related field. The other three did not have an employment offer as of graduation and have not reported back on the success or failure of their employment searches. The assessment goal was set at 50% employment in the field. This goal was achieved. However, tracking of graduates has been identified as a weakness of our program. A plan is being developed to tackle this issue.

Evaluation of student technical papers—Each student completes advanced laboratory, a six contact hour per week lab, as a graduation requirement. Students are graded on several reports of their work. No formal assessment instrument was devised. However, faculty report that students have poor writing skills when entering the class. The program is proposing a new course, CHEM 442 Communicating in the World of Chemistry, which will be taken concurrently with advanced lab. In this course, students will hear presentations from chemists, use the chemical literature, work on writing skills, and make formal presentations. Student learning

outcomes related to communication are expected to be assessed in this course. The class is planned to be introduced in the 2013-2014 academic year.

American Chemical Society (ACS) standardized tests—At the end of the second semester of general chemistry, the ACS standardized exam is given as the final. The exam is a multiple-choice, seventy-question exam. The mean of the scores of each class was calculated. The means were then converted to a percentile and averaged. The overall average for ten sections of General Chemistry II (CHEM 132) was at the 40th percentile. The ACS standardized final was also given in Organic Chemistry II (CHEM 311) in two years. The students scored at the 48th percentile. These scores are reasonable for the school and indicate that students are doing reasonably well. In the future, item analysis could be done on the CHEM 132 exams to determine any particular weak points of our students

Geology

The numbers presented here cover the period from fall 2006 (the date of the preceding program review) through summer 2012.

Exit exams—Fifty-one students have taken the geology exit exam. Results ranged from 53% to 91%, with a mean of 71%. Thus, all students scored higher than our criterion for success of 50%.

Graduate school—Nine out of the forty-six geology graduates applied for graduate school; all were successful. Six of these students have received graduate degrees in geology. One graduate is now an assistant professor of geology at Colorado School of Mines. Graduate schools include the University of Colorado-Boulder, Colorado School of Mines, University of New Mexico, University of Utah, Utah State University, Oklahoma State University, Arizona State University, Southern Illinois University, and Georgia Tech.

Employment in the field—Twenty-five graduates obtained jobs in the geosciences. Employers include state and federal agencies, mining companies, petroleum companies, oil-and-gas service companies (mudlogging and drilling), and geotechnical consulting. Several graduates have started their own successful companies. Other students have found professional employment outside of the geosciences, such as in GIST, law-enforcement, fire-fighting, counseling, and construction management.

Student publications and presentations—Sixty-four student researchers gave sixty-one presentations. Venues included meetings of the Geological Society of America, the American Association of Petroleum Geologists, the Upper Colorado River Basin Forum, and the Grand Junction Geological Society. Five recent graduates gave presentations at a meeting of a research consortium at the University of Colorado-Boulder. The consortium includes a CMU professor and is funded by fifteen energy companies.

Student awards and scholarships—A student was awarded the prestigious campus-wide Aspinall Scholarship two years in a row. Seven students received the Neal J. Harr Memorial Outstanding Geology Student Award given by the Rocky Mountain Association of Geologists in Denver.

Ten women students have received the Outstanding Geoscience Student Award given by the Association of Women Geoscientists Laramie Chapter since 2003. Eight students were awarded the Best Oral or Poster Presentation in the Sciences at the annual CMU Student Showcase. Twenty-seven students have been awarded scholarships, including the Scholes Memorial Scholarship, the GITA-Geospatial Scholarship from the Rocky Mountain Geographic Information and Technology Association, the Roadifer Scholarship, the Western Slope Oil and Gas Association Scholarship, the Grand Junction Geological Society Field Camp Scholarship, and the Grand Junction Gem and Mineral Club Scholarship.

Physics

The physics faculty members assess the progress of students on these objectives in each class. Additionally, all senior physics majors are required to give a physics seminar each semester which is assessed by the faculty.

Major Field Tests—All physics majors are required to take the ETS MFT in physics during their senior year. The MFTs in physics are taken by about 150 institutions across the country, enabling a comparison of our physics majors with those of other programs. The scores are reported in two subfields: introductory physics and advanced physics. Twenty-two senior physics majors have taken the physics MFT since spring 2006. Listed below is a table summarizing the national percentile rankings reported by ETS for these students.

Table 13. Results of Major Field Achievement Tests in Physics.

	Introductory Physics		Advanced Physics	
MFT Score Groups	Number of Students	Percentile Groups	Number of Students	Percentile Groups
20-29	1	5%	0	
30-39	9	10%-20%	6	5%-20%
40-49	4	25%-55%	6	25%-50%
50-59	2	55%-80%	4	50%-80%
60-69	3	80%-90%	2	80%-95%
70-80	3	>90%	4	>95%

Eight out of twenty-two graduates scored above the 55th percentile in introductory physics, while ten out of twenty-two scored above the 50th percentile in advanced physics. Notably, three students scored above the 90th percentile in introductory physics and four scored above the 95th percentile in advanced physics.

While our best physics students score very well, there is also a broad distribution of scores. These scores reflect the dual mission of our program. The physics major is accessible to many students, even those not planning to attend graduate school, and it is also a rigorous program that prepares students who are interested and motivated for admission to graduate school. The fact that our best students score very well nationally, as well as our successful placement of students in graduate schools, is a measure of our success in providing a rigorous program.

Graduate school—Five graduates were accepted to a variety of programs and schools, including physics at Purdue University, physics at Washington State University, astrophysics at University of Colorado-Boulder, atmospheric science at University of Colorado-Boulder, and nuclear engineering at Purdue University. (The student admitted to the atmospheric science program left after one year and obtained a Master's in Math Education from the University of Phoenix.)

Employment—Six graduates are known to have found employment in physics or a related field. Positions include research assistant at a Department of Energy national laboratory, petroleum engineer, water engineer, engineer, and middle school math teacher. The fate of the remaining graduates is unknown.

Student publications—All senior physics majors produce a senior research project. This is done under the direction of a faculty member and serves to integrate their undergraduate knowledge and apply it to an original physics problem. Several students have been recognized for their work. Three students have published their work in refereed journals (*Physical Review* and *Journal of Undergraduate Research in Physics*) since the last program review.

Student awards—A student received a Chambliss Astronomy Student Achievement award for her poster at the 220th American Astronomical Society meeting in Anchorage Alaska in 2012. Another student won the 2011 award for Outstanding Performance in Physics at the Los Alamos National Lab Student Symposium. Best Presentation by an Undergraduate Student was awarded to one of our students at the annual American Physical Society Four Corners Section Meeting in 2009. Still another student won an award for Best Oral Presentation at the 2011 Mesa State College Student Showcase.

3. Program improvements resulting from assessment

Chemistry

In response to our finding that chemistry majors need to improve their communications skills, we added a new course (to be offered for the first time in AY13), CHEM 344 Communication in Chemistry. The course will address laboratory notebooks, publishing research, formal oral presentations, resumés, and cover letters.

Geology

GEOL 202 Introduction to Field Studies and GEOL 204 Introduction to Computer Applications in Geology are now required for the geology degrees. These courses bridge the 100-level and upper-division courses and ensure that our graduates are competent in basic geological skills and technology.

4. Modifications to student learning outcomes

The faculty members of each program reconsidered their program learning objectives using the Degree Qualifications Profile as a guide, resulting in a set of program-level SLO's. Each course was then linked to the applicable program-level SLO's. The physical science faculty will formulate a new assessment plan in 2013 based on these SLO's.

Chemistry

Five SLO's were identified for graduates of the chemistry program. These SLO's and an assessment strategy for each are shown below. A matrix linking these program-level SLO's to specific chemistry courses is provided in Appendix VI.

Students who complete the B.S. in Physical Sciences with a concentration in chemistry will have demonstrated the ability to:

1) Articulate the knowledge base and show fluency with the ideas and techniques of the analytical, inorganic, organic, and physical chemistry (to be assessed using the Major Field Test);

2) Translate chemical problems into mathematical problems, solve these problems using appropriate mathematics, and extract chemically meaningful statements from the solution (to be assessed using the Major Field Test);

3) Utilize laboratory equipment and experimental techniques to analyze reaction rates and to synthesize, isolate, characterize, and quantify small molecules (to be assessed using projects in CHEM 341 Advanced Laboratory);

4) Extract experimental procedures from peer-reviewed publications and carry them out using the appropriate experimental techniques and laboratory equipment (to be assessed using a literature-based project in CHEM 341 Advanced Laboratory); and

5) Communicate effectively about topics in chemistry verbally and in writing (to be assessed using a new course, CHEM 442 Communication in the World of Chemistry, in conjunction with CHEM 341 Advanced Laboratory).

Geology

The four SLO's identified for graduates of the geology program are shown below. A matrix linking these program-level SLO's to specific geology courses is provided in Appendix VI.

Students who have completed the B.S. in Physical Sciences with a Concentration in Geology or Concentration in Environmental Geology will have demonstrated the ability to:

1) Understand geologic problems, collect and interpret field and/or laboratory data, and test hypotheses;

2) Conduct geologic studies including data compilation, report writing, and oral presentations;

3) Complete field-based studies that involve terminology, concepts, theories and practices in geology

4) Use instruments and technology for measuring and evaluating quantitative data (e.g., field and laboratory equipment, computer software)

Physics

The five SLO's identified for graduates of the physics program are listed below. A matrix linking these program-level SLO's to specific physics courses is provided in Appendix VI.

Students who have completed the B.S. in Physical Sciences with a Concentration in Physics will have demonstrated the ability to:

1) Articulate the knowledge base and show fluency with the ideas and techniques of the major fields of physics (classical mechanics, electromagnetism, statistical physics, and quantum theory);

2) Translate physical problems into mathematical problems, solve these using appropriate mathematics, and extract physically meaningful statements from the solutions;

3) Use laboratory equipment and experimental techniques to experimentally investigate physical phenomena;

4) Communicate effectively about topics in physics verbally and in writing; and

5) Execute a project which addresses a significant and complex issue in physics. This project will integrate knowledge and techniques from different areas of physics.

F. Future Program Plans

1. Vision

Members of the physical sciences faculty agree that chemistry, geology, and physics should each offer their own B.S. degree rather than concentrations within a B.S. in Physical Sciences. The current degree framework creates confusion among prospective students and their parents, and likely among potential employers and graduate school admission committees as well. Nor does this framework properly reflect that these three programs operate completely independent of each other.

We will propose three separate B.S. degrees to the Curriculum Committee in the spring 2013 semester, to be effective in August 2013. Our administration is in agreement with this proposal. Recent policy changes at the Colorado Commission on Higher Education will facilitate this action.

Chemistry

Our chemistry program currently excels at giving students personalized instruction with small upper division classes and faculty members who spend a lot of time meeting with students one-on-one. We plan to further customize our program to meet a diverse set of student needs by providing students with multiple pathways toward a B.S. in Chemistry and an additional pathway to a minor in chemistry. At the same time we want to supplement students' chemical knowledge with a greater understanding of the jobs available to them, how to attain these jobs, and how to excel at these jobs.

Geology

The Geology program offers up-to-date degree programs that provide students with technical and professional skills necessary for careers in the geosciences or further education in graduate school. Given the quality and experience of the tenure-track faculty and our location in western Colorado, we should be one of the best geology programs in the western region among similar institutions. With modest additions, the geology program has the potential to offer a M.S. professional (non-thesis) degree.

Physics

The goal of our program is to pursue excellence in teaching undergraduate physics. We provide a rigorous physics major program that gives our students the background to succeed in graduate school or the career of their choice. We also provide a variety of courses in the general education category and courses that are required by other majors.

2. Strengths and challenges

Chemistry

The major strengths of our chemistry program are customized, personal instruction and high quality instrumentation for an institution of our size. Our faculty spends a copious amount of time working with students individually, and our upper division courses are small. Our instrument holdings are as good or better than peer programs both state-wide and nationally. All students have opportunities to use each of these instruments through coursework in lab sections or research projects. The faculty provides research opportunities for all interested students, and the students are often able to obtain payment for their research through work-study programs.

The main challenge facing the chemistry program is a significant increase in chemistry majors, chemistry minors, and students requiring lower division chemistry courses for other majors. Based on the number of students currently enrolled in Physical Chemistry I, it seems likely that the number of graduating chemistry majors will jump from about four per year to possibly over ten within the next two years. This will mainly impact our two credit Advanced Laboratory course. It is required for chemistry majors, and it can only accommodate eight students due to instrumentation limitations. We currently offer one section per year, and it involves six hours of laboratory time per week. Furthermore, we plan to begin coupling it with a one credit chemistry communication course. Two professors will team-teach these courses simultaneously. Due to time constraints on our faculty, we will likely need to offer these courses both in the fall and spring semesters.

We also expect an increase in chemistry minors, particularly if we allow more flexibility in the courses required for the minor. Fortunately, we recently hired a tenure-track biochemistry faculty member. Furthermore, one tenured faculty member, who has previously taught organic chemistry and biochemistry, will soon be returning to full-time teaching from half-time teaching.

Our enrollments in general chemistry and organic chemistry courses have been consistently going up due to the growth of CMU. We have thus far been able to accommodate these changes with slight increases in course sizes, more sections, and the hiring of two tenure-track chemistry faculty members within the last two years. However, we will likely need to hire another faculty member within the next two years in order to accommodate further growth in both our lower division courses and upper division courses. A major challenge with the increases in class sizes (specifically in CHEM 121, 131, and 132) is the need for additional lab sections. Currently, we have twelve lab sections covered by temporary instructors. With enrollments in these courses increasing, the number of sections covered by temporary instructors will certainly increase as well.

Our other major challenge is meeting requirements for ACS certification. We are in the process of developing a pathway to a chemistry major which matches the ACS curriculum standards without requiring an increase in faculty workloads. However, ACS requires a maximum of 15 contact hours per week for a chemistry faculty member in a given semester. Half of our faculty members have 16 or more contact hours per week in an average semester due to the number of

labs that need to be staffed. We would have to find a way to reduce contact hours to attain certification.

Geology

We have several strengths. Geology students spend a great deal of time in the field. Through class field work and annual events such as the Western Slope Field Conference, students gain substantial field experience. Our faculty works closely with students throughout their time at CMU. We provide a large number of research-based learning opportunities outside of the classroom, which enhance their preparation for geosciences careers as well as graduate studies. We also offer useful degree options that students use to enhance their major. The Watershed Science minor is an unusual curriculum option. The GIST minor and certificate program also afford students with additional career options.

Our challenges lie in the areas of recruitment and equipment. Despite the increase in geology students over the past six years, our program still needs to do a better job at recruiting students. Geology is an "opportunistic" major. Few students show up at CMU with the intention of majoring in geology. Geology majors transfer into the degree program from some other major. We could do a better job of recruiting students by having a larger proportion of our 100-level courses taught by tenure-track faculty.

Our lab facilities and equipment, excluding the GIST computer lab, are either equal to or less than what we had prior to our previous review in 2006. We have gained new teaching labs, but in terms of research space and equipment, we would benefit from 1) a research workroom for describing, processing (trim saw work) and analyzing sediment samples and cores (work/dirty lab), 2) a new x-ray diffractometer, 3) a new EDAX adaptor for the scanning electron microscope (managed by biology, often used by geology), 4) at least five new petrographic microscopes, 5) new magnetometers and reflection/refraction seismographs, and 6) two additional research-quality, mapping-grade, high-resolution GPS units.

Physics

Strengths include small class sizes and our focus on teaching. We also provide our majors with opportunities to work closely with faculty members on research projects. Even though we have a small program (four tenured/tenure track faculty members), our diversity in background provides students with a relatively broad range of research opportunities.

We have been challenged by enrollment increases. There has been significant growth in our introductory "service" courses over the last five years. For example, in fall 2005 we had fifty-eight students enrolled in two sections of General Physics (PHYS 111) and twenty-six students enrolled in one section of Fundamental Mechanics (PHYS 131). In fall 2012 we have 151 students enrolled in 4 sections of PHYS 111 and 108 students enrolled in two sections of PHYS 131. An ideal class size for our quantitative introductory physics (which includes PHYS 111,112, 131, and 132) is twenty-four students. We are considerably over that size now in all of these classes; in fact our largest PHYS 131 class has an enrollment of fifty-eight. These targets could only be met by hiring two additional full-time faculty members. Without this, we may

need to change our teaching model for these classes to a large lecture class combined with smaller recitation sections.

Another problem arising from this enrollment growth is the difficulty in getting adequate classroom space at convenient times and places. Ideally, all our classes would be held in Wubben-Science; this would allow us to employ physics demonstrations in our classes. We are now using classrooms in buildings across campus and are having difficulty obtaining classrooms at preferred times.

We are presently graduating three to four physics majors each year. Ideally we would like to graduate ten to fifteen students each year. We have implemented a few strategies to market our program. We produced a promotional brochure which is distributed to regional high schools. We have developed a departmental website that describes our program. Our website includes a promotional video that was produced by the CMU Office of Development. CMU has also sponsored periodic campus "major fairs" that we have participated in.

We have been able to offer $5,000 in start-up money for recent new tenure-track faculty members. This has been adequate because recent hires were either theorists or computational physicists. A future hire could well be an experimental physicist. To be competitive in this area will require more start-up money; we can expect $50,000 or more start-up money to be offered to beginning experimental physicists at competing undergraduate institutions.

3. Trends

Chemistry

Our enrollments in general chemistry and organic chemistry courses have increased because of students needing these courses for other majors. Furthermore, based on the number of students currently enrolled in Physical Chemistry I, it seems likely that the number of graduating chemistry majors will potentially jump from about four per year to over ten within the next two years.

Geology

There has been a substantial increase in student interest in careers in petroleum geology. This interest is related to the increase in natural gas, oil shale, coal, and uranium development and exploration that has occurred in the Grand Junction region over the past 10 years. Although industry activity and employment opportunities are variable, interest in petroleum-related opportunities has been expressed by sophomore students as well as upper-division students that sign up for courses in energy resources and subsurface methods.

Physics

An important trend is the increase in introductory course enrollments described under Strengths and Challenges, above. Advances in physics research have been included in various special topics classes that we have offered since the last program review; we will continue this practice.

Consistent with new developments in physics pedagogy, we employ more "active" teaching methods in classes and include students in research projects.

4. Use of program review to improve teaching and learning

Chemistry

We have reassessed our student learning objectives at the course, minor, and major levels. At the same time, we are looking at how we assess these objectives and at how the students have performed in the past. We have identified student learning objectives for each course, and we have decided what should be required for both the minor and the major. Based on these conclusions, we have decided to diversify both our major and minor, as described in Section F.1. For both major and minor, we are beginning to develop options that concentrate on biochemistry due to the large number of students interested in both biology and chemistry. Furthermore, we are working to develop a major that meets the ACS standards for curriculum. We believe that this will improve the competitiveness of our students when they enter the job market or apply for chemistry graduate schools.

In modifying our curriculum to provide students with multiple pathways toward a B.S. in Chemistry, we plan to offer students three possible degrees: a B.S. in Chemistry, a B.S. in Chemistry that meets the American Chemical Society (ACS) curriculum standards, and a B.S. in Chemistry with a Concentration in Biochemistry (or possibly a B.S. in Biochemistry). We are currently adding Inorganic Chemistry I, Instrumental Analysis, and a chemistry communication course to the list of required core chemistry courses for this degree. We also plan to offer students a B.S. in Chemistry that meets the ACS curriculum standards. This change should improve students' competitiveness in achieving positions at chemistry graduate schools, national laboratories, and chemical companies. The ACS certified chemistry pathway simply requires students to take Biochemistry I with Lab (four credits) and two credits of Structured Research with formal reports as part of their restricted electives. We would look to eventually get this degree approved by the ACS, but this may be challenging due to our faculty's relatively high number of contact hours.

We also plan to develop a B.S. in Chemistry with a Concentration in Biochemistry which would appeal to a wide variety of students with plans for entering the biochemical industry, biochemistry graduate school, medical school, dental school, veterinary school, or pharmacy school. This option would also help to accommodate students with a background in biology that enter the chemistry major later in their undergraduate careers. The biochemistry concentration would require the development of one new course, Biochemistry II, as well as a significant number of modifications to our B.S. in Chemistry. For this major, we envision dropping Calculus III (four credits) and Physical Chemistry II (three credits) from our list of required core chemistry courses. These will be replaced with Biochemistry I with Lab (four credits), and Biochemistry II with Lab (four credits). A few biology classes including molecular biology will be added into the core courses and restricted electives, but these will still fit within the mandated 120 credit hours for a major.

We have modified the chemistry minor to better accommodate the large number of interested students. Currently, there is no flexibility in the courses required for the minor. All chemistry minors are required to take General Chemistry I and II, Organic Chemistry I and II, Quantitative Analysis, and the corresponding lab courses. This structure is not ideal for many students; for example, it may be more appropriate for students interested in medical school to take Biochemistry I instead of Quantitative Analysis.

Utilizing our chemistry club and a course in chemistry communication, we plan to improve our students' understanding of possible career paths while helping them to attain the specific communication skills necessary for achieving their career goals. Our chemistry club has been restarted within the past year. Into it, we are building regular discussions of the steps that students need to take in order to reach their career objectives. We discuss research opportunities and internships as well as the variety of positions available to graduates with chemistry degrees. Furthermore, we plan to bring in speakers from various backgrounds who can address these topics.

We also have developed a chemistry communications course to aid students in developing the communication skills that they will need for obtaining and keeping a job in a chemistry-related field. It will address cover letters, resumés, laboratory notebooks, publishing research, and formal oral presentations. Furthermore, it will be coupled to our Advanced Laboratory course so that students can get practice reporting on experiments that they have performed.

Geology

GEOL 202 Introduction to Field Studies and GEOL 204 Introduction to Computer Applications in Geology are now required for the geology degree. These courses bridge the 100-level and upper-division courses and ensure that our graduates are competent in basic geological skills and technology.

Physics

Several recommendations from the last program review have been implemented. We have new lab space for intermediate labs and electronics labs. We have increased our marketing efforts and have produced a physics website.

5. Recommendations for addressing challenges

Chemistry

The main challenge to the chemistry program is being able to accommodate an on-going increase in majors, minors, and students requiring chemistry courses for other majors. If enrollments continue to increase at a high rate, the chemistry program will need to hire another full-time faculty member to begin as early as the fall semester of 2014.

Geology

We have the following recommendations for addressing challenges and advancing the geology program.

Develop a petroleum geology track—The trend in student interest toward oil and gas geology should be addressed by creating a new program track, similar the petroleum geology degree at Western State Colorado University. We will research petroleum program initiatives at other schools and work towards expanding petroleum and "soft-rock" course offerings in 2013. This expansion of course offerings will be used to fully evaluate the viability of adding a petroleum degree option. Additional faculty resources would be needed here, especially in the areas of petroleum engineering, structural geology, and geophysics.

Additional tenure-track geology faculty—As a teaching school, we should have a greater proportion of our 100-level courses taught by tenure-track faculty. Our current tenure-track faculty can only teach a few of these courses as well as cover our required upper-division courses. In addition, we will need additional teaching help if we are to offer additional petroleum-related courses or develop an advanced-degree program. As tenured faculty retire, it is crucial that they be replaced by tenure-track, doctoral-level candidates.

M.S. Degree in Geology—We would like to implement an M.S. in Geology within the next five years. This would require a substantial increase in funding for additional faculty, equipment, infrastructure, and research.

Infrastructure—We need to upgrade existing equipment and procure new analytical equipment by soliciting donations to the CMU Foundation from the energy and minerals sectors.

Physics

Our main challenge is keeping up with enrollment growth in freshman-level classes. To ensure that we keep these classes close to their optimum size, we should hire as many as two new full-time faculty members. Additionally, we need classroom space in Wubben-Science in order to facilitate the use of demonstrations in class. A couple of classrooms dedicated to teaching physics classes would be ideal.

Appendix I

Program Sheets

COLORADO MESA UNIVERSITY

2012-2013 PETITION/PROGRAM SHEET
Degree: Bachelor of Science
Major: Physical Sciences
Concentration: Chemistry

About This Major . . .

This concentration is a classic chemistry curriculum comparable to those offered at colleges and universities across the nation. As of 2007 it consists of two semesters each of general, organic and physical chemistry, one semester of analytical chemistry and two electives chosen from a list including biochemistry, instrumental analysis, advanced organic and advanced inorganic. Opportunities for student research abound and the physical and environmental sciences department is well equipped with modern chemical instrumentation, including a 300 MHz NMR, liquid chromatograph and an ICP atomic emission spectrophotometer.

Colorado Mesa graduates have been successful in finding jobs in the chemical industry and secondary education, as well as being placed in graduate, pharmacy, and medical schools. As of summer 2006 all of the chemistry majors who have applied to medical school have been successful in being admitted. Our graduates have completed Ph.D. programs at the University of Denver, Arizona State University, University of Utah and University of Wyoming, in chemistry, biomedical engineering and environmental engineering.

For more information on what you can do with this major, go to http://www.coloradomesa.edu/career/whatmajor.html.

POLICIES:

1. It is your responsibility to determine whether you have met the requirements for your degree. Please see the Catalog for a complete list of graduation requirements.
2. You must turn in your "Intent to Graduate" form to the Registrar's Office **by September 15 if you plan to graduate the following May, and by February 15 if you plan to graduate the following December**.
3. This program sheet must be submitted with your graduation planning sheet to your advisor during the **semester prior to the semester of graduation, no later than October 1 for spring graduates, no later than March 1 for fall graduates.**
4. Your advisor will sign and forward the Program Sheet and Graduation Planning Sheet to the Department Head for signature.
5. Finally, the Department Head or the department administrative assistant will take the signed forms to the Registrar's Office. (Students cannot handle the forms once the advisor signs.)
6. If your petition for graduation is denied, it will be your responsibility to reapply for graduation in a subsequent semester. Your "Intent to Graduate" does not automatically move to a later graduation date.
7. NOTE: The semester before graduation, you will be required to take a Major Field Achievement Test (exit exam).

NAME: _____ **STUDENT ID #** _____

LOCAL ADDRESS AND PHONE NUMBER: _____

_____ ( ) _____

I, (Signature) _____, hereby certify that I have completed (or will complete) all the courses listed on the Program Sheet. I further certify that the grade listed for those courses is the final course grade received except for the courses in which I am currently enrolled and the courses which I complete next semester. I have indicated the semester in which I will complete these courses.

_____ _____ 20____
Signature of Advisor Date

_____ _____ 20____
Signature of Department Head Date

_____ _____ 20____
Signature of Registrar Date

Students should work closely with a faculty advisor when selecting and scheduling courses prior to registration.

Degree Requirements:

- 120 semester hours total (A minimum of 28 taken at CMU in no fewer than two semesters).
- 40 upper division credits (A minimum of 15 taken at the 300-400 course levels within the major at CMU).
- Pre-collegiate courses (usually numbered below 100) cannot be used for graduation.
- 2.00 cumulative GPA or higher in all CMU coursework
- A "C" or higher is required in all major and foundation courses.
- A student must follow the CMU graduation requirements either from 1) the program sheet for the major in effect at the time the student officially declares a major; or 2) a program sheet for the major approved for a year subsequent to the year during which the student officially declares the major and is approved for the student by the department head. Beeause a program may have requirements specific to the degree, the student should check with the faculty advisor for additional criteria. It is the student's responsibility to be aware of, and follow, all requirements for the degree being pursued. Any exceptions or substitutions must be approved by the student's faculty advisor and Department Head.
- When filling out the program sheet a course can be used only onee.
- See the "Undergraduate Graduation Requirements" in thc College catalog for additional graduation information.

GENERAL EDUCATION REQUIREMENTS (31 semester hours)
See the current catalog for a list of courses that fulfill the requirements below. If a course is on the general education list of options and a requirement for your major, you must use it to fulfill the major requirement and make a different selection within the general education requirement.

Course No	Title	Sem.hrs	Grade	Term/Trns
English (6 semester hours, must receive a grade of "C" or better and must be completed by the time the student has 60 semester hours.)				
ENGL 111	English Composition	3		
ENGL 112	English Composition	3		
Math: (3 semester hours, must receive a grade of "C" or better, must be completed by the time the student has 60 semester hours.)				
MATH 151	Calculus I	5*		
*3 credits apply to the Gencral Ed requirements and 2 credits apply to foundation credit				
Humanities (3 semester hours)				
Social and Behavioral Sciences (6 semester hours)				
Natural Sciences (7 semester hours, one course must include a lab)				
	L			
History (3 semester hours)				
HIST				
Fine Arts (3 semester hours)				

Course No	Title	Sem.hrs	Grade	Term/Trns
OTHER LOWER DIVISION REQUIREMENTS (6 semester hours)				
Kinesiology (3 semester hours)				
KINE 100	Health and Wellness	1		
KINA 1		1		
KINA 1		1		
Applied Studies (3 semester hours)				
FOUNDATION COURSES (17 semester hours) A "C" or higher is required in all foundation courses.				
MATH 151	Calculus I	2		
MATH 152	Calculus II	5		
PHYS 131	Fundamental Mechanics			
OR		4		
PHYS 111	General Physics			
PHYS 131L	Fundamental Mechanics Laboratory			
OR		1		
PHYS 111L	General Physics Laboratory			
PHYS 132	Electromagnetism & Optics			
OR		4		
PHYS 112	General Physics			
PHYS 132L	Electromagnetism & Optics Laboratory			
OR		1		
PHYS 112L	General Physics Laboratory			
PHYSICAL SCIENCES – CHEMISTRY MAJOR REQUIREMENTS (43semester hours) A "C" or higher is required in all major courses.				
Core Physical Sciences-Chemistry Courses (36 semester hours) All students complete the following courses:				
CHEM 131	General Chemistry	4		
CHEM 131L	General Chemistry Lab	1		
CHEM 132	General Chemistry	4		
CHEM 132L	General Chemistry Lab	1		
CHEM 211	Quantitative Analysis	3		
CHEM 211L	Quantitative Analysis Lab	1		
CHEM 311	Organic Chemistry	4		
CHEM 311L	Organic Chemistry Lab	1		
CHEM 312	Organic Chemistry	4		
CHEM 312L	Organic Chemistry Lab	1		
CHEM 321	Physical Chemistry I	3		
CHEM 322	Physical Chemistry II	3		
CHEM 341	Advanced Laboratory I	2		
MATH 253	Calculus III	4		
Restricted Electives (7 semester hours) Courses are to be chosen from the list on pg 3:				
ELECTIVES (All college level courses appearing on your final transcript, **not listed above** that will bring your total semester hours to 120 hours.) (23 semester hours; 15 hours upper division may be needed.)				

Course No	Title	Sem.hrs	Grade	Term/Trns

Course No	Title	Sem.hrs	Grade	Term/Trns

RESTRICTED ELECTIVES:

CHEM 315/315L Biochemistry and Lab (3) / (1)
CHEM 342 Advaneed Laboratory II (2)
CHEM 396 Topics (1-3)
CHEM 397 Structurcd Research (1-3)
CHEM 411 Main Group Elements (3)
CHEM 412 Transition Elements (3)
CHEM 421 Advanced Organic Chemistry I (3)
CHEM 422 Advanced Organic Chemistry II (3)
CHEM 431/431L Instrumental Analysis and Lab (3) / (1)
CHEM 482 Senior Research I (2)
CHEM 494 Seminar (1)
CHEM 496. Topics (3)

SUGGESTED COURSE SEQUENCING FOR A MAJOR IN PHYSICAL SCIENCES - CHEMISTRY

This is a recommended sequence of course work. Certain courses may have prerequisites or are only offered during the Fall or Spring semesters. It is the student's responsibility to meet with the assigned advisor and check the 2 year course matrix on the Colorado Mesa website for course availability.

FRESHMAN YEAR

Fall Semester		Hours
CHEM 131	General Chemistry	4
CHEM 131L	General Chemistry Lab	1
ENGL 111	English Composition	3
MATH 151	Calculus 1	5
General Education Natural Science		3
		16

Spring Semester		Hours
CHEM 132	General Chemistry	4
CHEM 132L	General Chemistry Lab	1
ENGL 112	English Composition	3
MATH 152	Calculus II	5
General Education Natural Science with lab		4
		17

SOPHOMORE YEAR

Fall Semester		Hours
CHEM 211	Quantitative Analysis	3
CHEM 211L	Quantitative Analysis Lab	1
CHEM 311	Organic Chemistry	4
CHEM 311L	Organic Chemistry Lab	1
MATH 253	Calculus III	4
PHYS 131	Fundamental Mechanics	4
PHYS 131L	Fundamental Mechanics Lab	1
		18

Spring Semester		Hours
CHEM 312	Organic Chemistry	4
CHEM 312L	Organic Chemistry Lab	1
PHYS 132	Electromagnetism & Optics	4
PHYS 132L	Electromagnetism & Optics Lab	1
KINE 100	Health and Wellness	1
General Education Fine Arts		3
		14

JUNIOR YEAR

Fall Semester		Hours
CHEM 321	Physical Chemistry I	3
General Education History		3
General Education Social/Behavioral Science		6
Elective		3
		15

Spring Semester		Hours
CHEM 322	Physical Chemistry II	3
CHEM 341	Advanced Laboratory I	2
General Education Humanities		3
General Education Social/Behavioral Science or Humanities		3
KINA	Activity	1
Elective		3
		15

SENIOR YEAR

Fall Semester		Hours
General Education Applied Studies		3
KINA	Activity	1
Restricted Electives		3
Elective		3
Unrestricted Upper Division Elective		3
		13

Spring Semester	Hours
Restricted Elective	4
Unrestricted Upper Division Electives	8
	12

COLORADO MESA UNIVERSITY

2012-2013 PETITION/PROGRAM SHEET
Minor: Chemistry

About This Minor . . .

Chemistry can be described as the systematic study of matter in the universe. It is often referred to as the "central science" in that it acts as the connection between many other disciplines including physics, biology, engineering, earth science, environmental science and medicine. As such, a strong background in chemistry is a wonderful complement to many other majors. A chemistry minor should be considered by any student who is interested in a career in science, medicine, patent law, forensics, or technical sales.

POLICIES:

1. It is your responsibility to determine whether you have met the requirements for your degree. Please see the eatalog for a complete list of graduation requirements.
2. You must turn in your "Intent to Graduate" form to the Registrar's Office **by September 15 if you plan to graduate the following May, and by February 15 if you plan to graduate the following December**.
3. This program sheet must be submitted with your graduation planning sheet to your advisor during the **semester prior to the semester of graduation, no later than October 1 for spring graduates, no later than March 1 for fall graduates.**
4. Your advisor will sign and forward the Program Sheet and Graduation Planning Sheet to the Department Head for signature.
5. Finally, the Department Head or the department administrative assistant will take the signed forms to the Registrar's Office. (Students cannot handle the forms once the advisor signs.)
6. If your petition for graduation is denied, it will be your responsibility to reapply for graduation in a subsequent semester. Your "Intent to Graduate" does not automatically move to a later graduation date.
7. NOTE: The semester before graduation, you may be required to take a Major Field Achievement Test (exit exam).

NAME: _____ **STUDENT ID #** _____

LOCAL ADDRESS AND PHONE NUMBER: _____

_____ ( ) _____

_____

I, (Signature)_____, hereby certify that I have completed (or will complete) all the courses listed on the Program Sheet. I further certify that the grade listed for those courses is the final course grade received except for the courses in which I am currently enrolled and the courses which I complete next semester. I have indicated the semester in which I will complete these courses.

_____ _____ 20_____
Signature of Chemistry Advisor Date

_____ _____ 20_____
Signature of Department Head Date

_____ _____ 20_____
Signature of Registrar Date

Students should work closely with a faculty advisor when selecting and scheduling courses prior to registration. See the "Undergraduate Graduation Requirements" in the catalog for additional graduation information.

Minor Requirements:

- At least 33 percent of the credit hours required for the minor must be in courses numbered 300 or above.
- 2.00 cumulative GPA or higher in the minor is required
- Pre-collegiate courses (usually numbered below 100) cannot be used for graduation.
- The number of minors a student may receive at Colorado Mesa University shall not exceed two.
- A student must follow the CMU graduation requirements either from 1) the program sheet for the major in effect at the time the student officially declares a major; or 2) a program sheet for the major approved for a year subsequent to the year during which the student officially declares the major and is approved for the student by the department head. Because a program may have requirements specific to the degree, the student should check with the faculty advisor for additional criteria. It is the student's responsibility to be aware of, and follow, all requirements for the degree being pursued. Any exceptions or substitutions must be approved by the student's faculty advisor and Department Head.

REQUIRED COURSES (24 Semester Hours)

See the current catalog for a list of courses that fulfill the requirements below.

Course No	Title	Sem.hrs	Grade	Term/Trns
CHEM 131	General Chemistry	4		
CHEM 131L	General Chemistry Lab	1		
CHEM 132	General Chemistry	4		
CHEM 132L	General Chemistry Lab	1		
CHEM 211	Quantitative Analysis	3		
CHEM 211L	Quantitative Analysis Lab	1		
CHEM 311	Organic Chemistry	4		
CHEM 311L	Organic Chemistry Lab	1		
CHEM 312	Organic Chemistry	4		
CHEM 312L	Organic Chemistry Lab	1		

COLORADO MESA UNIVERSITY

2012-2013 PETITION/PROGRAM SHEET
Degree: Bachelor of Science
Major: Physical Sciences
Concentration: Geology

About This Major . . .

The Bachelor of Science degree with a major in Physical Sciences and a concentration in Geology is designed for students who (1) desire a strong liberal arts education with emphasis on the earth sciences, (2) wish to pursue a graduate degree in geology, or (3) desire a professional or technical geoscience career. Recent graduates are attending graduate programs at major universities or have entered the work force as geological technicians or professional geologists. Instruction takes place in a state-of-the-art science complex, which houses several instructional laboratories, a projects room, computer-applications laboratory, class preparation room, petrology-mineralogy laboratory, rock-storage facilities, and a sample preparation room. Most classes have a strong field component so that students can enjoy the diverse geological setting of the Grand Junction area. Equipment available includes research petrographic microscopes, binocular microscopes, a computer-assisted x-ray diffractometer, several scanning-electron microscopes (available through the Biology Department), GPS units, short-period and long-period seismometers, and a magnetometer. Computer facilities include modern PC systems with software basics for communications, database management, word-processing, geographical information systems (GIS), and geostatistics.

For more information on what you can do with this major, go to http://www.coloradomesa.edu/career/whatmajor.html

POLICIES:

1. It is your responsibility to determine whether you have met the requirements for your degree. Please see the Catalog for a complete list of graduation requirements.
2. You must turn in your "Intent to Graduate" form to the Registrar's Office **by September 15 if you plan to graduate the followiug May and by February 15 if you plan to graduate the following Deeember.**
3. This program sheet must be submitted with your graduation planning sheet to your advisor during the **semester prior to the semester of graduation, no later than October 1 for spring graduates, no later than March 1 for fall graduates.**
4. Your advisor will sign and forward the Program Sheet and Graduation Planning Sheet to the Departinent Head for signature.
5. Finally, the Department Head or the department administrative assistant will take the signed forms to the Registrar's Office. (Studcnts cannot handle the forms once the advisor signs.)
6. If your petition for graduation is denicd, it will be your responsibility to reapply for graduation in a subsequent semester. Your "Intent to Graduate" does not automatically move to a later graduation date.
7. NOTE: The semester before graduation, you will be required to take a Major Field Achievement Test (exit exam).

NAME: _____ **STUDENT ID #** _____

LOCAL ADDRESS AND PHONE NUMBER: _____

_____ ( ) _____

I, (Signature)_____, hereby eertify that I have completed (or will eomplete) all the courses listed on the Program Sheet. I further certify that the grade listed for those courses is the final course grade received exeept for the courses in which I am currently enrolled and the courses which I complete next semester. I have indicated the semester in whieh I will complete these courses.

_____ _____ 20_____
Signature of Advisor Date

_____ _____ 20_____
Signature of Department Head Date

_____ _____ 20_____
Signature of Registrar Date

Students should work closely with a faculty advisor when selecting and scheduling courses prior to registration.

Degree Requirements:

- 120 semester hours total (A minimum of 28 taken at CMU in no fewer than two semesters).
- 40 upper division credits (A minimum of 15 taken at the 300-400 course levels within the major at CMU).
- 2.00 cumulative GPA or higher in all CMU coursework
- A "C" or higher is required in all major and foundation courses.
- Pre-collegiate courses (usually numbered below 100) cannot be used for graduation.
- A student must follow the CMU graduation requirements either from 1) the program sheet for the major in effect at the time the student officially declares a major; or 2) a program sheet for the major approved for a year subsequent to the year during which the student officially declares the major and is approved for the student by the department head. Because a program may have requirements specific to the degree, the student should check with the faculty advisor for additional criteria. It is the student's responsibility to be aware of, and follow, all requirements for the degree being pursued. Any exceptions or substitutions must be approved by the student's faculty advisor and Department Head.
- When filling out the program sheet a course can be used only once.
- See the "Undergraduate Graduation Requirements" in the catalog for additional graduation information.

GENERAL EDUCATION REQUIREMENTS (31 semester hours)
See the current catalog for a list of courses that fulfill the requirements below. If a course is on the general education list of options and a requirement for your major, you must use it to fulfill the major requirement and make a different selection within the general education requirement.

Course No	Title	Sem.hrs	Grade	Term/Trns
English (6 semester hours, must receive a grade of "C" or better and must be completed by the time the student has 60 semester hours.)				
ENGL 111	English Composition	3		
ENGL 112	English Composition	3		
Math: (3 semester hours, must receive a grade of "C" or better, must be completed by the time the student has 60 semester hours.)				
MATH 151	Calculus I	5*		
*3 credits apply to the General Ed requirements and 2 credits apply to Foundation Courses				
Humanities (3 semester hours)				
Social and Behavioral Sciences (6 semester hours)				
Natural Sciences (7 semester hours, one course must include a lab)				
BIOL 102/102L **or** BIOL 105/105L **or** PHYS 112/112L **or** PHYS 132/132L **or** CHEM 132/132L				
	L			
History (3 semester hours)				
HIST				
Fine Arts (3 semester hours)				

Course No	Title	Sem.hrs	Grade	Term/Trns
OTHER LOWER DIVISION REQUIREMENTS (6 semester hours)				
Kinesiology (3 semester hours)				
KINE 100	Health and Wellness	1		
KINA 1		1		
KINA 1		1		
Applied Studies (3 semester hours)				
FOUNDATION COURSES (15 semester hours)				
CHEM 131	General Chemistry	4		
CHEM 131L	General Chemistry Lab	1		
PHYS 111/111L **or** PHYS 131/131L				
PHYS		4		
PHYS L		1		
STAT 200	Probability and Statistics	3		
*MATH 151	Calculus I	2		
PHYSICAL SCIENCES MAJOR – GEOLOGY CONCENTRATION REQUIREMENTS (56 semester hours) A "C" or higher is required in all major courses.				
Geology Core Courses (39 semester hours)				
GEOL 111/111L or GEOL 113/113L *				
*GEOL		3		
*GEOL L		1		
* Either GEOL 111/111L or GEOL 113/113L may be taken for credit, but not both.				
GEOL 112	Principles of Historical Geology	3		
GEOL 112L	Principles of Historical Geology Lab	1		
GEOL 202	Introduction to Field Studies	3		
GEOL 204	Computer Applications in Geology	3		
GEOL 301	Structural Geology	3		
GEOL 301L	Structural Geology Lab	1		
GEOL 331	Crystallography & Mineralogy	3		
GEOL 331L	Crystallography & Mineralogy Lab	1		
GEOL 402	Applications of Geomorphology	3		
GEOL 402L	Applications of Geomorphology Lab	1		
GEOL 444	Stratigraphy and Sedimentation	3		
GEOL 444L	Stratigraphy and Sedimentation Lab	1		
GEOL 480	Summer Field Camp	6		
GEOL 490	Seminar	3		
Required Geology Courses (8 semester hours)				
GEOL 340	Igneous & Metamorphic Petrology	3		
GEOL 340L	Igneous & Metamorphic Petrology Lab	1		
GEOL 404	Geophysics	3		
GEOL 404L	Geophysics Lab	1		

Course No	Title	Sem.hrs	Grade	Term/Trns

Restricted Electives (9 semester hours) chosen from list below.
NOTE: Seven hours of Restricted and General Electives must be upper division.

Course No	Title	Sem.hrs	Grade	Term/Trns

ELECTIVES (All college level courses appearing on your final transcript, **not listed above** that will bring your total semester hours to 120 hours. 12 semester hours.)
NOTE: Seven hours of Restricted and General Elcetives must be upper division.

RESTRICTED ELECTIVES:

GEOL 250 Environmental Geology (3)
GEOL 325 Intro to Engineering Geology (3)
GEOL 355 Basic Hydrology (3)
GEOL 359 Surv of Energy-Related Nat Resources (3)
GEOL 361 Surv of Mineral-Related Nat Resources (3)
GEOL 370 Renewable Energy (3)
GEOL 394 Natural Resources of the West (1)
GEOL 411 Paleontology (3)
GEOL 411L Paleontology Lab (1)
GEOL 415 Introduction to Ground Water (3)
GEOL 415L Intro to Ground Water Lab (1)
GEOL 455 River Dynamics (3)
GEOL 455L River Dynamics Lab (1)
GEOL 497 Structured Researeh (1-3)
ENVS 312 Soil Science and Sustainability (3)
ENVS 312L Soil Science and Sust Lab (1)
CHEM 132 General Chemistry (4)
CHEM 132L General Chemistry Lab (1)
MATH 152 Calculus II (5)
STAT 311 Statistical Methods (3)
**PHYS 112 General Physics (4)
and PHYS 112L General Physics Lab (1)
or **PHYS 132 Electromag and Optics (4)
and PHYS 132L Electromag and Optics Lab(1)

**Either PHYS 112/112L or PHYS 132/132L may be taken for credit, but not both.

SUGGESTED COURSE SEQUENCING FOR A MAJOR IN PHYSICAL SCIENCE – GEOLOGY

This is a recommended sequence of course work. Certain courses may have prerequisites or are only offered during the Fall or Spring semesters. It is the student's responsibility to meet with the assigned advisor and check the 2 year course matrix on the Colorado Mesa website for course availability.

FRESHMAN YEAR

Fall Semester		Hours
GEOL 111*	Principles of Physical Geology **and**	3
GEOL 111L*	Principles of Physical Geology Lab **OR**	1
GEOL 113*	Fld. Based Intro to Phys Geology **and**	3
GEOL 113L*	Fld. Based Intro to Phys Geology Lab	1
ENGL 111	English Composition	3
MATH 151	Calculus I	5
General Education History		3
		15

Spring Semester		Hours
GEOL 112	Principles of Historical Geology	3
GEOL 112L	Principles of Historical Geology Lab	1
ENGL 112	English Composition	3
General Education Humanities		3
General Education Social/Behavioral Science		3
KINA	Activity	1
KINE	Health and Wellness	1
		15

SOPHOMORE YEAR

Fall Semester		Hours
GEOL 202	Intro to Field Studies	3
CHEM 131	General Chemistry	4
CHEM 131L	General Chemistry Lab	1
PHYS 111**	General Physics **and**	4
PHYS 111L**	General Physics Lab **OR**	1
PHYS 131**	Fundamental Mechanics **and**	4
PHYS 131L**	Fundamental Mechanics Lab	1
General Education Social/Behavioral Science		3
		16

Spring Semester		Hours
GEOL 204	Computer Applications in Geology	3
STAT 200	Probability and Statistics	3
General Education Natural Science		3
General Education Natural Science with Lab		4
General Education Fine Arts		3
		16

JUNIOR YEAR

Fall Semester		Hours
GEOL 301	Structural Geology	3
GEOL 301L	Structural Geology Lab	1
GEOL 331	Crystallography & Mineralogy	3
GEOL 331L	Crystallography & Mineralogy Lab	1
General Education Applied Studies		3
Electives		3
		14

Spring Semester		Hours
GEOL 340	Igneous & Metamorphic Petrology	3
GEOL 340L	Igneous & Metamorphic Petrology Lab	1
Electives		9
		13

SENIOR YEAR

Fall Semester		Hours
GEOL 402	Applications of Geomorphology	3
GEOL 402L	Applications of Geomorphology	1
Restricted Electives		9
		13

Spring Semester		Hours
GEOL 404	Geophysics	3
GEOL 404L	Geophysics Lab	1
GEOL 444	Stratigraphy & Sedimentation	3
GEOL 444L	Stratigraphy & Sedimentation Lab	1
GEOL 490	Seminar	3
KINA	Activity	1
		12

Summer Semester		Hours
GEOL 480	Summer Field Camp	6

* Either GEOL 111/111L or GEOL 113/113L may be taken for credit, but not both.
**Either PHYS 111/111L or PHYS 131/131L may be taken for credit, but not both.

COLORADO MESA UNIVERSITY

2012-2013 PETITION/PROGRAM SHEET
Degree: Bachelor of Science
Major: Physical Sciences
Concentration: Geology
Option: Environmental Geology

About This Major . . .

The Bachelor of Science degree with a major in Physical Sciences and a concentration in Geology with an Environmental Geology option is designed for students who (1) desire a strong liberal arts education with emphasis on environmental issues within the earth sciences, (2) wish to pursue a graduate degree in environmental geology, or (3) desire a professional or technical career. The Environmental Geology option has the same basic framework as the Geology concentration with a stronger emphasis on geologic hazards, ground-water and surface-water hydrology, low-temperature geochemistry, biological systems, and environmental science. Recent graduates are attending graduate programs at major universities or have entered the work force as geological technicians or professional geologists.

Most classes have a strong field component so that students can enjoy the diverse geological setting of the Grand Junction area. Equipment available includes research petrographic microscopes, binocular microscopes, a computer-assisted x-ray diffractometer, several scanning-electron microscopes (available through the Biology Department), GPS units, short-period and long-period seismometers, and a magnetometer. Computer facilities include modern PC systems with software for communications, database management, word-processing, geographical information systems (GIS) and geostatistics.

For more information on what you can do with this major, go to http://www.coloradomesa.edu/career/whatmajor.html.

POLICIES:

1. It is your responsibility to determine whether you have met the requirements for your degree. Please see the Catalog for a complete list of graduation requirements.
2. You must turn in your "Intent to Graduate" form to the Registrar's Office **by September 15 if you plan to graduate the following May and by February 15 if you plan to graduate the following December**.
3. This program sheet must be submitted with your graduation planning sheet to your advisor during the **semester prior to the semester of graduation, no later than October 1 for spring graduates, no later than March 1 for fall graduates.**
4. Your advisor will sign and forward the Program Sheet and Graduation Planning Sheet to the Department Head for signature.
5. Finally, the Department Head or the department administrative assistant will take the signed forms to the Registrar's Office. (Students cannot handle the forms once the advisor signs.)
6. If your petition for graduation is denied, it will be your responsibility to reapply for graduation in a subsequent semester. Your "Intent to Graduate" does not automatically move to a later graduation date.
7. NOTE: The semester before graduation, you will be required to take a Major Field Achievement Test (exit exam).

NAME: _____ **STUDENT ID #** _____

LOCAL ADDRESS AND PHONE NUMBER: _____

_____ ( ) _____

I, (Signature)_____, hereby certify that I have completed (or will complete) all the courses listed on the Program Sheet. I further certify that the grade listed for those courses is the final course grade received except for the courses in which I am currently enrolled and the courses which I complete next semester. I have indicated the semester in which I will complete these courses.

_____ _____ 20_____
Signature of Advisor Date

_____ _____ 20_____
Signature of Department Head Date

_____ _____ 20_____
Signature of Registrar Date

Students should work closely with a faculty advisor when selecting and scheduling courses prior to registration.

Degree Requirements:

- 120 semester hours total (A minimum of 28 taken at CMU in no fewer than two semesters).
- 40 upper division credits (A minimum of 15 taken at the 300-400 course levels within the major at CMU).
- Pre-collegiate courses (usually numbered below 100) cannot be used for graduation.
- 2.00 cumulative GPA or higher in all CMU coursework
- A "C" or higher is required in all major and foundation courses.
- A student must follow the CMU graduation requirements either from 1) the program sheet for the major in effect at the time the student officially declares a major; or 2) a program sheet for the major approved for a year subsequent to the year during which the student officially declares the major and is approved for the student by the department head. Because a program may have requirements specific to the degree, the student should check with the faculty advisor for additional criteria. It is the student's responsibility to be aware of, and follow, all requirements for the degree being pursued. Any exceptions or substitutions must be approved by the student's faculty advisor and Department Head.
- When filling out the program sheet a course can be used only once.
- See the "Undergraduate Graduation Requirements" in the catalog for additional graduation information.

GENERAL EDUCATION REQUIREMENTS (31 semester hours)
See the current catalog for a list of courses that fulfill the requirements below. If a course is on the general education list of options and a requirement for your major, you must use it to fulfill the major requirement and make a different selection within the general education requirement.

Course No	Title	Sem.hrs	Grade	Term/Trns
English (6 semester hours, must receive a grade of "C" or better and must be completed by the time the student has 60 semester hours.)				
ENGL 111	English Composition	3		
ENGL 112	English Composition	3		
Math: (3 semester hours, must receive a grade of "C" or better, must be completed by the time the student has 60 semester hours.)				
MATH 151	Calculus I	5*		
*3 credits apply to the General Ed requirements and 2 credits apply to Foundation Courses				
Humanities (3 semester hours)				
Social and Behavioral Sciences (6 semester hours)				
Natural Sciences (7 semester hours, one course must include a lab)				
BIOL 102/102L or BIOL 105/105L or PHYS 112/112L or PHYS 132/132L or CHEM 132/132L				
	L			
History (3 semester hours)				
HIST				
Fine Arts (3 semester hours)				

Course No	Title	Sem.hrs	Grade	Term/Trns
OTHER LOWER DIVISION REQUIREMENTS (6 semester hours)				
Kinesiology (3 semester hours)				
KINE 100	Health and Wellness	1		
KINA 1		1		
KINA 1		1		
Applied Studies (3 semester hours)				
FOUNDATION COURSES (15 semester hours)				
CHEM 131	General Chemistry	4		
CHEM 131L	General Chemistry Lab	1		
PHYS 111/111L or PHYS 131/131L				
PHYS		4		
PHYS L		1		
STAT 200	Probability and Statistics	3		
*MATH 151	Calculus I	2		
PHYSICAL SCIENCES MAJOR – ENVIRONMENTAL GEOLOGY CONCENTRATION REQUIREMENTS (58 semester hours)				
Geology Core Courses (39 semester hours)				
GEOL 111/111L or GEOL 113/113L *				
*GEOL		3		
*GEOL L		1		
* Either GEOL 111/111L or GEOL 113/113L may be taken for credit, but not both.				
GEOL 112	Principles of Historical Geology	3		
GEOL 112L	Principles of Historical Geology Lab	1		
GEOL 202	Introduction to Field Studies	3		
GEOL 204	Computer Applications in Geology	3		
GEOL 301	Structural Geology	3		
GEOL 301L	Structural Geology Lab	1		
GEOL 331	Crystallography & Mineralogy	3		
GEOL 331L	Crystallography & Mineralogy Lab	1		
GEOL 402	Applications of Geomorphology	3		
GEOL 402L	Applications of Geomorphology Lab	1		
GEOL 444	Stratigraphy and Sedimentation	3		
GEOL 444L	Stratigraphy and Sedimentation Lab	1		
GEOL 480	Summer Field Camp	6		
GEOL 490	Seminar	3		
Required Geology Courses (10 semester hours)				
GEOL 250	Environmental Geology	3		
GEOL 355	Basic Hydrology	3		
GEOL 415	Intro to Ground Water	3		
GEOL 415L	Intro to Ground Water Lab	1		

Course No Title Sem.hrs Grade Term/Trns

Restricted Electives (9 semester hours) chosen from the list below
NOTE: Eight hours of Restricted and General Electives must be upper division.

**Either PHYS 112/112L or PHYS 132/132L may be taken for credit, but not both.

Course No Title Sem.hrs Grade Term/Trns

ELECTIVES (All college level courses appearing on your final transcript, **not listed above** that will bring your total semester hours to 120 hours. 10 semester hours)
NOTE: Eight hours of Restricted and General Electives must be upper division.

RESTRICTED ELECTIVES:

GEOL 325 Introduction to Engineering Geology (3)
GEOL 359 Surv of Energy-Related Nat Resources (3)
GEOL 361 Surv of Mineral-Related Natural Resources (3)
GEOL 370 Renewable Energy (3)
GEOL 394 Natural Resources of the West (1)
GEOL 404 Geophysics (3)
GEOL 404L Geophysics Lab (1)
GEOL 455 River Dynamics (3)
GEOL 455L River Dynamics Lab (1)
GEOL 497 Structured Research (1-3)
ENVS 312 Soil Science and Sustainability (3)
ENVS 312L Soil Science and Sustainability Lab (1)
ENVS 313 Charaeterization of Contaminated Sites (3)
ENVS 313L Characterization of Cont Sites Lab (1)
POLS 488 Environmental Politics and Policy (3)
CHEM 132 General Chemistry (4)
CHEM 132L General Chemistry Lab (1)
MATH 152 Calculus II (5)
STAT 311 Statistical Methods (3)
**PHYS 112 General Physics (4)
and PHYS 112L General Physics Lab (1)
or **PHYS 132 Electromagnetism and Optics (4)
and PHYS 132L Electromagnetism and Optics Lab (1)
**Either PHYS 112/112L or PHYS 132/132L may be taken for credit, but not both.

SUGGESTED COURSE SEQUENCING FOR A MAJOR IN PHYSICAL SCIENCE – ENVIRONMENTAL GEOLOGY

This is a recommended sequence of course work. Certain courses may have prerequisites or are only offered during the Fall or Spring semesters. It is the student's responsibility to meet with the assigned advisor and check the 2 year course matrix on the Colorado Mesa website for course availability.

FRESHMAN YEAR

Fall Semester		Hours
GEOL 111*	Principles of Physical Geology and	3
GEOL 111L*	Principles of Physical Geology Lab **or**	1
GEOL 113*	Fld. Based Intro to Phys Geology **and**	3
GEOL 113L*	Fld. Based Intro to Phys Geology Lab	1
ENGL 111	English Composition	3
MATH 151	Calculus I	5
General Education History		3
		15

Spring Semester		Hours
GEOL 112	Principles of Historical Geology	3
GEOL 112L	Principles of Historical Geology Lab	1
ENGL 112	English Composition	3
General Education Humanities		3
General Education Social/Behavioral Science		3
KINE 100	Health and Wellness	1
KINA	Activity	1
		15

SOPHOMORE YEAR

Fall Semester		Hours
GEOL 202	Introduction to Field Studies	3
GEOL 250	Environmental Geology	3
CHEM 131	General Chemistry	4
CHEM 131L	General Chemistry Lab	1
PHYS 111**	General Physics **and**	4
PHYS 111L**	General Physics Lab **OR**	1
PHYS 131**	Fundamental Mechanics **and**	4
PHYS 131L**	Fundamental Mechanics Lab	1
		16

Spring Semester		Hours
GEOL 204	Computer Applications in Geology	3
STAT 200	Probability and Statistics	3
General Education Social/Behavioral Science		3
Electives		3
General Education Natural Science		3
		15

JUNIOR YEAR

Fall Semester		Hours
GEOL 301	Structural Geology	3
GEOL 301L	Structural Geology	1
GEOL 331	Crystallography & Mineralogy	3
GEOL 331L	Crystallography & Mineralogy Lab	1
GEOL 355	Basic Hydrology	3
General Education Natural Science with Lab		4
		15

Spring Semester	Hours
General Education Fine Arts	3
General Education Applied Studies	3
Elective	3
Restricted Electives	4
	13

SENIOR YEAR

Fall Semester		Hours
GEOL 402	Applications of Geomorphology	3
GEOL 402L	Applications of Geomorphology	1
Restricted Electives		5
Electives		4
		13

Spring Semester		Hours
GEOL 415	Introduction to Ground Water	3
GEOL 415L	Introduction to Ground Water Lab	1
GEOL 444	Stratigraphy and Sedimentation	3
GEOL 444L	Stratigraphy and Sedimentation	1
GEOL 490	Seminar	3
KINA	Activity	1
		12

Summer Semester		Hours
GEOL 480	Summer Field Camp	6

* Either GEOL 111/111L or GEOL 113/113L may be taken for credit, but not both.
**Either PHYS 111/111L or PHYS 131/131L may be taken for credit, but not both.

COLORADO MESA UNIVERSITY

2012-2013 PETITION/PROGRAM SHEET
Degree: Bachelor of Science
Major: Physical Sciences
Concentration: Geology
Option: Secondary Teaching

About This Major . . .

The Earth Science secondary licensure degree is structured for graduates to pursue teaching careers at the middle or high school level. The basic curriculum includes all of the major topics within a traditional geology program while also incorporating teacher education courses required for licensure by the state of Colorado. The degree plan includes basic chemistry, physics, and biology. Instruction takes placed in a state of the art science complex on campus which houses several instructional laboratories, projects rooms, a computer applications lab, petrology-mineralogy lab, and rock storage facilities. Most classes include a strong field component allowing students to take advantage of the diverse geological setting of the Grand Junction area. Students have access to department equipment that includes research petrographic microscopes, binocular microscopes, a computer-assisted x-ray diffractometer, scanning electron microscopes, GPS units, short- and long-period seismometers, and a magnetometer.

The secondary licensure program provides teacher education candidates with broad content knowledge in science and prepares them as teachers for grades 7 through 12. A minimum of 75 credit hours of general education and content area coursework must be completed with a minimum GPA of 2.80 before a candidate may apply for admission to the Center for Teacher Education secondary licensure program. Please see the Teacher Education Admission Packet for further information on admissions criteria. EDUC 211, *Foundations of Education*, must be taken before applying to the program.

For more information on what you can do with this major, go to http://www.coloradomesa.edu/career/whatmajor.html

POLICIES:

1. It is your responsibility to determine whether you have met the requirements for your degree. Please see the Catalog for a complete list of graduation requirements.
2. You must turn in your "Intent to Graduate" form to the Registrar's Office **by September 15 if you plan to graduate the following May, and by February 15 if you plan to graduate the following December.**
3. This program sheet must be submitted with your graduation planning sheet to your advisor during the **semester prior to the semester of graduation, no later than October 1 for spring graduates, no later than March 1 for fall graduates.**
4. Your advisor will sign and forward the Program Sheet and Graduation Planning Sheet to the Department Head for signature.
5. Finally, the Department Head or the department administrative assistant will take the signed forms to the Registrar's Office. (Students cannot handle the forms once the advisor signs.)
6. If your petition for graduation is denied, it will be your responsibility to reapply for graduation in a subsequent semester. Your "Intent to Graduate" does not automatically move to a later graduation date.
7. NOTE: The semester before graduation, you will be required to take an exit exam.

NAME: _____ **STUDENT ID #** _____

LOCAL ADDRESS AND PHONE NUMBER: _____

_____ ( ) _____

I, (Signature)_____, hereby certify that I have completed (or will complete) all the courses listed on the Program Sheet. I further certify that the grade listed for those courses is the final course grade reeeived exeept for the courses in which I am currently enrolled and the courses which I complete next semester. I have indicated the semester in which I will complete these courses.

_____ _____ 20____
Signature of Advisor Date

_____ _____ 20____
Signature of Content Advisor Date

_____ _____ 20____
Signature of Department Head Date

_____ _____ 20____
Signature of Registrar Date

Students should work closely with a faculty advisor when selecting and scheduling courses prior to registration.

Degree Requirements:

- 126 semester hours total (A minimum of 28 taken at CMU in no fewer than two semesters).
- 40 upper division credits (A minimum of 15 taken at the 300-400 course levels within the major at CMU).
- 2.80 cumulative GPA or higher in all CMU coursework
- Pre-collegiate courses (usually numbered below 100) cannot be used for graduation.
- A cumulative grade point average of 2.8 or higher must be maintained for each of 3 areas: content courses, education courses and overall GPA.
- A "C" or higher is required in all major and foundation courses.
- A student must follow the CMU graduation requirements either from 1) the program sheet for the major in effect at the time the student officially declares a major; or 2) a program sheet for the major approved for a year subsequent to the year during which the student officially declares the major and is approved for the student by the department head. Because a program may have requirements specific to the degree, the student should check with the faculty advisor for additional criteria. It is the student's responsibility to be aware of, and follow, all requirements for the degree being pursued. Any exceptions or substitutions must be approved by the student's faculty advisor and Department Head.
- When filling out the program sheet a course can be used only once.
- See the "Undergraduate Graduation Requirements" in the catalog for additional graduation information.
- Students must PASS the PLACE or PRAXIS II exam in the content area prior to beginning the internship. Also, ALL other coursework toward the degree must be successfully completed prior to the internship.

GENERAL EDUCATION REQUIREMENTS (31 semester hours)
See the current catalog for a list of courses that fulfill the requirements below. If a course is on the general education list of options and a requirement for your major, you must use it to fulfill the major requirement and make a different selection within the general education requirement.

Course No	Title	Sem.hrs	Grade	Term/Trns
English (6 semester hours, must receive a grade of "B" or better and must be completed by the time the student has 60 semester hours.)				
ENGL 111	English Composition	3		
ENGL 112	English Composition	3		
Math: (3 semester hours, must receive a grade of "C" or better, must be completed by the time the student has 60 semester hours.)				
MATH 113	College Algebra	4*		
*3 credits apply to the General Ed requirements and 1 credit applies to Foundation Courses				
Humanities (3 semester hours)				
Social and Behavioral Sciences (6 semester hours)				
PSYC 233	Human Growth & Development	3		
(PSYC 233 required with a grade of "B" or better)				
GEOG 103 recommended				
History (3 semester hours)				
HIST				
Fine Arts (3 semester hours)				

Course No	Title	Sem.hrs	Grade	Term/Trns
Natural Sciences (7 semester hours, one course must include a lab)				
BIOL 105	Attributes of Living Systems	3		
BIOL 105L	Attributes of Living Systems	1		
OTHER LOWER DIVISION REQUIREMENTS (6 semester hours)				
Kinesiology (3 semester hours)				
KINE 100	Health and Wellness	1		
KINA 1		1		
KINA 1		1		
Applied Studies (3 semester hours)				
SPCH 102	Speechmaking	3		
(SPCH 102 Required with a grade of "B" or better)				
FOUNDATION COURSES (17 semester hours)				
CHEM 131	General Chemistry	4		
CHEM 131L	General Chemistry Lab	1		
PHYS 101	Elementary Astronomy	3		
PHYS 111	General Physics	4		
PHYS 111L	General Physics Lab	1		
*MATH 113	College Algebra	1		
MATH 130	Trigonometry	3		
GEOLOGY – LEADING TO SECONDARY TEACHING LICENSURE MAJOR REQUIREMENTS (40 semester hours)				
A "C" or higher is required in all major courses.				
Required Core Courses (40 semester hours)				
*Choose either GEOL 103 or GEOL 104				
*GEOL		3		
GEOL 111	Principles of Physical Geology	3		
GEOL 111L	Principles of Physical Geology Lab	1		
GEOL 112	Principles of Historical Geology	3		
GEOL 112L	Principles of Historical Geology Lab	1		
GEOL 202	Introduction to Field Studies	3		
GEOL 204	Computer Applications in Geology	3		
GEOL 250	Environmental Geology	3		
GEOL 301	Structural Geology	3		
GEOL 301L	Structural Geology Lab	1		
GEOL 331	Crystallography & Mineralogy	3		
GEOL 331L	Crystallography & Mineralogy Lab	1		
GEOL 340	Igneous and Metamorphic Petrology	3		
GEOL 340L	Igneous and Metamorphic Petrology Lab	1		
GEOL 402	Applications of Geomorphology	3		
GEOL 402L	Applications of Geomorphology Lab	1		
GEOL 444	Sedimentology and Stratigraphy	3		
GEOL 444L	Sedimentology and Stratigraphy Lab	1		
Electives (3 semester hours)				

Secondary Education Requirements (29 Semester Hours)
***Prerequisites:** ENGL 111, ENGL 112, SPCH 102, PSYC 233, EDUC 211 (all with a grade of B or better), MATH 113 or higher (with grade of C or higher, Declared major in Geology – Leading to Secondary Teacher Licensure and formal acceptance to the Teacher Education Program

Course No	Title	Sem.hrs	Grade	Term/Trns	
EDUC 211	Foundations of Education	2			20 Field Experience Hours
EDUC 342*	Pedagogy & Assessment: Secondary/K-12	3			20 Field Experience Hours
EDUC 343*	Teaching to Diversity	3			20 Field Experience Hours
EDUC 442*	Integrating Literacy Across the Curriculum	4			60 Field Experience Hours
EDUC 497*	Content Methodology Practicum	3			80 Field Experienee Hours with EDUC 497D
EDUC 497D**	Methods of Teaching Secondary Science	2			
EDUC 499G*	Teaching Internship and Colloquium	12			600 Field Experience Hours

Students must PASS the PLACE or PRAXIS II exam in the content area prior to commencing the internship. Also, ALL other coursework toward the degree must be successfully completed prior to the internship.

**This course is only offered in the fall semester. It may be taken with either the 300-level or 400-level EDUC courses but must be taken before the student teaching semester.

***All EDUC prefix courses listed above must be completed with a grade of B or better to progress through the program sequence.

SUGGESTED COURSE SEQUENCING FOR A MAJOR IN GEOLOGY – LEADING TO SECONDARY TEACHER LICENSURE

This is a recommended sequence of course work. Certain courses may have prerequisites and/or are only offered during the Fall or Spring semesters. It is the student's responsibility to meet with the assigned advisor and check the 2 year course matrix on the Colorado Mesa website for course availability.

FRESHMAN YEAR

Fall Semester		Hours
GEOL 103	Weather and Climate or	
GEOL 104	Oceanography	3
GEOL 111	Principles of Physical Geology	3
GEOL 111L	Principles of Physical Geology Lab	1
ENGL 111	English Composition	3
MATH 113	College Algebra	4
KINE 100	Health and Wellness	1
		15

Spring Semester		Hours
GEOL 112	Principles of Historical Geology	3
GEOL 112L	Principles of Historical Geology Lab	1
ENGL 112	English Composition	3
MATH 130	Trigonometry	3
PSYC 233	Human Growth and Development	3
SPCH 102	Speechmaking	3
KINA	Activity	1
		17

SOPHOMORE YEAR

Fall Semester		Hours
GEOL 202	Introduction to Field Studies	3
GEOL 250	Environmental Geology	3
CHEM 131	General Chemistry	4
CHEM 131L	General Chemistry Lab	1
PHYS 111	General Physics	4
PHYS 111L	General Physics Lab	1
		16

Spring Semester		Hours
GEOL 204	Computer Applications in Geology	3
BIOL 105	Attributes of Living Systems	3
BIOL 105L	Attributes of Living Systems	1
PHYS 101	Elementary Astronomy	3
General Education Fine Arts		3
General Education Social/Behavioral Science (GEOG 103 World Regional Geography Recommended)		3
KINA	Activity	1
		17

JUNIOR YEAR

Fall Semester		Hours
GEOL 301	Structural Geology	3
GEOL 301L	Structural Geology Lab	1
GEOL 331	Crystallography and Mineralogy	3
GEOL 331L	Crystallography and Mineralogy lab	1
General Education Natural Sciences		3
General Education History		3
*EDUC 211	Foundations in Education	2
		16

**Must be taken prior to acceptance into the Center for Teacher Education. Offered in summer, fall and spring semesters.

Spring Semester		Hours
GEOL 340	Igneous & Metamorphic Petrology	3
GEOL 340L	Igneous & Metamorphic Petrology	1
GEOL 444	Sedimentology and Stratigraphy	3
GEOL 444L	Sedimentology and Stratigraphy Lab	1
EDUC 342	Pedagogy/Assessment: Secondary/K-12	3
EDUC 343	Teaching to Diversity	3
Elective		3
		17

*May be taken prior to acceptance into the Cente

SENIOR YEAR

Fall Semester		Hours
GEOL 402	Applications of Geomorphology	3
GEOL 402L	Applications of Geomorphology Lab	1
General Education Humanities		3
EDUC 442	Integrating Literacy: Secondary/K-12 Art	4
EDUC 497	Content Methods Practicum	3
EDUC 497D*	Methods of Teaching Secondary Science	2
		16

Spring Semester		Hours
EDUC 499G	Teach. Intern/Colloquium: Secondary	12
		12

*Only offered in fall

COLORADO MESA UNIVERSITY

2012-2013 PETITION/PROGRAM SHEET
Degree: Associate of Science
Major: Liberal Arts
Emphasis: Geology

About This Emphasis . . .

The Associate of Science (A.S.) degree is designed for students who intend to continue their education and obtain a baccalaureate degree. The A.S. is the appropriate choice for students who will take upper division coursework in mathematics, biological sciences, and physical sciences. The degree program includes the Colorado Statewide General Education Core and meets the lower division general education requirements at most public institutions in Colorado. A number of emphases are available within the A.S. degree. Students choosing one of these emphases will take courses in a discipline in addition to the general education core.

An Associate of Science (A.S.) degree with a geology emphasis is offered through the Physical and Environmental Sciences Department. This degree prepares students for employment as geological technicians in government and industry, or for entrance into the geology baccalaureate program at Colorado Mesa University or other four-year institutions. The curriculum includes basic courses in geology as well as general-education courses. All of the geology courses place emphasis on the spectacular geologic features in western Colorado and eastern Utah.

For more information on what you can do with this major, go to http://www.coloradomesa.edu/career/whatmajor.html.

POLICIES:

1. It is your responsibility to determine whether you have met the requirements for your degree. Please see the catalog for a complete list of graduation requirements.
2. You must turn in your "Intent to Graduate" form to the Registrar's Office **by September 15 if you plan to graduate the following May, and by February 15 if you plan to graduate the following December.**
3. This program sheet must be submitted with your graduation planning sheet to your advisor during the **semester prior to the semester of graduation, no later than October 1 for spring graduates, no later than March 1 for fall graduates.**
4. Your advisor will sign and forward the Program Sheet and Graduation Planning Sheet to the Department Head for signature.
5. Finally, the Department Head or the department administrative assistant will take the signed forms to the Registrar's Office. (Students cannot handle the forms once the advisor signs.)
6. If your petition for graduation is denied, it will be your responsibility to reapply for graduation in a subsequent semester. Your "Intent to Graduate" does not automatically move to a later graduation date.

NAME: _____ **STUDENT ID #** _____

LOCAL ADDRESS AND PHONE NUMBER: _____

_____ ( ) _____

I, (Signature)_____, hereby certify that I have completed (or will complete) all the courses listed on the Program Sheet. I further certify that the grade listed for those courses is the final course grade received except for the courses in which I am currently enrolled and the courses which I complete next semester. I have indicated the semester in which I will complete these courses.

_____ _____ 20_____
Signature of Advisor Date

_____ _____ 20_____
Signature of Department Head Date

_____ _____ 20_____
Signature of Registrar Date

Students should work closely with a faculty advisor when selecting and scheduling courses prior to registration.

Degree Requirements:

- 60 semester hours total (A minimum of 16 taken at CMU in no fewer than two semesters).
- 2.00 cumulative GPA or higher in all CMU coursework and a grade of "C" or better must be earned toward the major content area
- A grade of "C" or higher must be earned in all general education courses in order to be accepted for the transfer under the Core Transfer Agreements.
- Pre-collegiate courses (usually numbered below 100) cannot be used for graduation.
- A student must follow the CMU graduation requirements either from 1) the program sheet for the major in effect at the time the student officially declares a major; or 2) a program sheet for the major approved for a year subsequent to the year during which the student officially declares the major and is approved for the student by the department head. Because a program may have requirements specific to the degree, the student should check with the faculty advisor for additional criteria. It is the student's responsibility to be aware of, and follow, all requirements for the degree being pursued. Any exceptions or substitutions must be approved by the student's faculty advisor and Department Head.
- When filling out the program sheet a course can be used only once.
- See the "Undergraduate Graduation Requirements" in the catalog for additional graduation information.

GENERAL EDUCATION REQUIREMENTS (31 semester hours)
See the current catalog for a list of courses that fulfill the requirements below. If a course is on the general education list of options and a requirement for your major, you must use it to fulfill the major requirement and make a different selection within the general education requirement.

Course No	Title	Sem.hrs	Grade	Term/Trns
English (6 semester hours, must receive a grade of "C" or better and must be completed by the time the student has 60 semester hours.)				
ENGL 111	English Composition	3		
ENGL 112	English Composition	3		
Math: MATH 113 **or higher** (3 semester hours, must receive a grade of "C" or better, must be completed by the time the student has 60 semester hours.)				
MATH 113	College Algebra	4*		
*3 credits apply to the General Ed requirements and 1 credit applies to Geology Specialization Courses				
Humanities (3 semester hours)				
Social and Behavioral Sciences (6 semester hours)				
Natural Sciences (7 semester hours, one course must include a lab)				
	L			

Course No	Title	Sem.hrs	Grade	Term/Trns
History (3 semester hours)				
HIST				
Fine Arts (3 semester hours)				
OTHER LOWER DIVISION REQUIRMENTS (5 semester hours)				
Kinesiology (2 semester hours)				
KINE 100	Health and Wellness	1		
KINA 1		1		
Applied Studies (3 semester hours)				

GEOLOGY EMPHASIS CORE REQUIREMENTS
(25 semester hours)

Core Classes
Must choose either: GEOL 111/111L or GEOL 113/113L

GEOL 111	Principles of Physical Geology	3		
GEOL 111L	Principles of Physical Geology Lab	1		
OR				
GEOL 113	Field Based Intro to Physical Geology	3		
GEOL 113L	Field Based Intro to Physical Geology Lab	1		
Either GEOL 111/111L or GEOL 113/113L may be taken for credit, but not both.				
GEOL 112	Principles of Historical Geology	3		
GEOL 112L	Principles of Historical Geology Lab	1		
GEOL 250	Environmental Geology	3		

Required Geology Specialization Courses (14 Semester Hours) To be selected in consultation with student's advisor

*MATH 113	College Algebra	1		

SUGGESTED COURSE SEQUENCING FOR THE ASSOCIATE OF SCIENCE WITH A MAJOR IN LIBERAL ARTS - EMPHASIS IN GEOLOGY

This is a recommended sequence of course work. Certain courses may have prerequisites or are only offered during the Fall or Spring semesters. It is the student's responsibility to meet with the assigned advisor and check the 2 year course matrix on the Colorado Mesa website for course availability.

FRESHMAN YEAR

Fall Semester		Hours
GEOL 111	Principles of Physical Geology and	
GEOL 111L	Principles of Physical Geology Lab or	
GEOL 113	Field Based Intro to Phys. Geology and	3
GEOL 113L	Field Based Intro to Phys. Geol. Lab	1
ENGL 111	English Composition	3
MATH 113	College Algebra (or higher)	4
Elective		3
KINE 100	Health and Wellness	1
		15

Spring Semester		Hours
GEOL 112	Principles of Historical Geology	3
GEOL 112L	Principles of Historical Geology Lab	1
ENGL 112	English Composition	3
General Education Natural Science		4
General Education Social/Behavioral Science		3
KINA	Activity	1
		15

SOPHOMORE YEAR

Fall Semester		Hours
GEOL 250	Environmental Geology	3
Geology Specialization Selections		6
General Education Humanities		3
General Education Natural Science		4
		16

Spring Semester	Hours
Geology Specialization Selection	4
Geology Specialization Selection	4
General Education Humanities	3
General Education Social/Behavioral Science	3
	14

COLORADO MESA UNIVERSITY

2012-2013 PETITION/PROGRAM SHEET
Minor: Geology

About This Minor . . .

The Geology Minor is designed for students who wish to take additional basic geology courses in support of their degree aspirations in other areas. A total of 21 geology credit hours are required. Instruction takes place in a state-of-the-art science complex, and is supported by five tenure-track faculty members, plus four instructors. Most classes have a strong field component so that students can enjoy the diverse geological setting of the Grand Junction area.

POLICIES:

1. It is your responsibility to determine whether you have met the requirements for your degree. Please see your catalog for a complete list of graduation requirements.
2. You must go to the Registrar's Office and fill out the "Intent to Graduate" form **at the beginning of the semester prior to graduating.**
3. This program sheet must be submitted with your graduation planning sheet to your advisor during the **semester prior to graduating, no later than September 15 for Spring graduates, February 15 for Fall graduates.**
4. Your advisor will sign and forward the Program Sheet, Intent to Graduate Form, and Graduation Planning Sheet to the Department Head for signature.
5. Finally, the Department Head or the department administrative assistant will take the signed forms to the Registrar's Office. (Students cannot handle the forms once the advisor signs.)
6. If your petition for graduation is denied, it will be your responsibility to reapply for graduation in a subsequent semester. Your "Intent to Graduate" does not automatically move to a later graduation date.

NAME: _____ **STUDENT ID #** _____

LOCAL ADDRESS AND PHONE NUMBER: _____

_____ ( ) _____

I, (Signature)_____, hereby certify that I have completed (or will complete) all the courses listed on the Program Sheet. I further certify that the grade listed for those courses is the final course grade received except for the courses in which I am currently enrolled and the courses which I complete next semester. I have indicated the semester in which I will complete these courses.

_____ _____ 20_____
Signature of Advisor Date

_____ _____ 20_____
Signature of Department Head Date

_____ _____ 20_____
Signature of Registrar Date

Students should work closely with a faculty advisor when selecting and scheduling conrses prior to registration. See the "Undergraduate Graduation Requirements" in the catalog for additional graduation information.

Minor Requirements:

- At least 33 percent of the credit hours required for the minor must be in courses numbered 300 or ahove.
- 2.00 cumulative GPA or higher in the minor is required
- Pre-collegiate courses (usually numbered below 100) cannot be used for graduation.
- The number of minors a student may receive at Colorado Mesa University shall not exceed two.
- A student must follow the CMU graduation requirements either from 1) the program sheet for the major in effect at the time the student officially declares a major; or 2) a program sheet for the major approved for a year subsequent to the year during which the student officially declares thc major and is approved for the student by the department head. Because a program may have requirements specific to the degree, the studcnt should check with the faculty advisor for additional criteria. It is the student's responsibility to be aware of, and follow, all requircments for the degree being pursued. Any exceptions or substitutions must be approved by the studcnt's faculty advisor and Department Head.

REQUIRED COURSES (14 Semester Hours Minimnm)

Sce the current catalog for a list of courses that fulfill thc requirements below.

Course No	Title	Scm.hrs	Grade	Term/Trns
GEOL 111	Principles of Physical Geology	3		
GEOL 111L	Principles of Physical Geology Lab	1		
OR				
GEOL 113	Ficld Based Introduction to Physical Geology	3		
GEOL 113L	Field Based Introduction to Physical Geology Lab	1		
(Either GEOL 111/111L or GEOL 113/113L may be taken for credit, but not both.)				
GEOL 112	Principles of Historical Geology	3		
GEOL 112L	Principles of Historical Geology Lab	1		
GEOL 202	Introduction to Field Studies	3		
GEOL 250	Environmental Geology	3		

Course No	Title	Sem.hrs	Grade	Term/Trns
Electives, 7 Semester Hours (minimum) chosen from the following:				
GEOL 204	Computer Applications in Geology	3		
GEOL 301	Structural Geology	3		
GEOL 301L	Structural Geology Lab	1		
GEOL 325	Intro to Engincering Geology	3		
GEOL 321	Intro to Remote Sensing	2		
GEOL 321L	Intro to Remotc Sensing Lab	1		
GEOL 331	Crystallography & Mineralogy	3		
GEOL 331L	Crystallography & Mineralogy Lab	1		
GEOL 340	Igneous & Metamorphic Petrology	3		
GEOL 340L	Igneous & Metamorphic Petrology Lab	1		
GEOL 359	Survey of Energy-Related Natural Resources	3		
GEOL 361	Survey of Mineral-Related Natural Resources	3		
GEOL 402	Applications of Geomorphology	3		
GEOL 402L	Applieations of Geomorphology Lab	1		
GEOL 404	Geophysics	3		
GEOL 404L	Geophysics Lab	1		
GEOL 411	Paleontology	3		
GEOL 411L	Paleontology Lab	1		
GEOL 444	Sedimentology & Stratigraphy	3		
GEOL 444L	Sedimentology & Stratigraphy Lab	1		

COLORADO MESA UNIVERSITY

2012-2013 PETITION/PROGRAM SHEET
Minor: Geographic Information Science and Technology

About this Minor . . .

The Physical and Environmental Sciences (PES) Department at Colorado Mesa University offers a minor in Geographic Information Science and Technology. The courses are open to all students interested in broadening their knowledge and enhancing job-related skills in a rapidly expanding market of computer-based technology. The multidisciplinary nature of the geographic information science and technology allows students from a wide variety of fields to participate in this exciting program.

Geographic Information Science and Technology includes Geographic Information Systems, Global Positioning Systems, and Remote Sensing. A geographic information system (GIS) is a computer-based tool for mapping and analyzing things that exist, and events that happen on earth. GIS technology is a special case of information systems where the database consists of features, activities, or events that are definable in space as points, lines, or areas. GPS (Global Positioning System) is a satellite system that allows users to collect precise geographic data for use in mapping. Remote sensing refers to any technique whereby information about objects and the environment is obtained from a distance such as aircrafts or satellites. The remote sensing often permits us to greatly expand our spectral view of the earth and "see" the world much more clearly than we can with the unaided eye.

There is a strong demand for people who are trained in Geographic Information Science and Technology and this minor will assist students in securing jobs in this rapidly growing field. GIS/GPS can be used for cartography, business, biology, geology, environmental science, history, archeology, and criminal justice.

POLICIES:

1. It is your responsibility to determine whether you have met the requirements for your degree. Please see the catalog for a complete list of graduation requirements.
2. You must turn in your "Intent to Graduate" form to the Registrar's Office **by September 15 if you plan to graduate the following May, and by February 15 if you plan to graduate the following December.**
3. This program sheet must be submitted with your graduation planning sheet to your advisor during the **semester prior to the semester of graduation, no later than October 1 for spring graduates, no later than March 1 for fall graduates.**
4. Your advisor will sign and forward the Program Sheet and Graduation Planning Sheet to the Department Head for signature.
5. Finally, the Department Head or the department administrative assistant will take the signed forms to the Registrar's Office. (Students cannot handle the forms once the advisor signs.)
6. If your petition for graduation is denied, it will be your responsibility to reapply for graduation in a subsequent semester. Your "Intent to Graduate" does not automatically move to a later graduation date.
7. NOTE: The semester before graduation, you may be required to take a Major Field Achievement Test (exit exam).

NAME: _____ **STUDENT ID #** _____

LOCAL ADDRESS AND PHONE NUMBER: _____

_____ ( ) _____

I, (Signature)_____, hereby certify that I have completed (or will complete) all the courses listed on the Program Sheet. I further certify that the grade listed for those courses is the final course grade received except for the courses in which I am currently enrolled and the courses which I complete next semester. I have indicated the semester in which I will complete these courses.

_____ _____ 20_____
Signature of Geographic Information Systems Advisor Date

_____ _____ 20_____
Signature of Department Head Date

_____ _____ 20_____
Signature of Registrar Date

Students should work closely with a faculty advisor when selecting and scheduling courses prior to registration.

Degree Requirements:

- At least 33 percent of the credit hours required for the minor must be in courses numbered 300 or above.
- A GPA of 2.00 or higher in the minor is required.
- The number of minors a student may receive at Colorado Mesa University shall not exceed two.
- A student must follow the graduation requirements either from 1) the program sheet for the major in effect at the time the student officially declares a major; or 2) a program sheet for the major approved for a year subsequent to the year during which the student officially declares the major and is approved for the studeut by the department head. Because a program may have requirements specific to the degree, the student should check with the faculty advisor for additional criteria. It is the student's responsibility to be aware of, and follow, all requirements for the degree being pursued. Any exceptions or substitutions must be approved by the student's faculty advisor and Department Head.
- When filling out the program sheet a course can be used only once.
- See the "Undergraduate Graduation Requirements" in the catalog for additional graduation information.

Course No	Title	Sem.hrs	Grade	Term/Trns
REQUIRED COURSES (16 Semester hours minimum)				
GEOL 305	Cartography for GIS	1		
OR				
GEOG 131	Introduction to Cartography	3		
GEOL 321	Introduction to Remote Sensing	2		
GEOL 321L	Introduction to Remote Sensing Lab	1		
GEOL 332	Introduction to GIS (BIOL, ENVS)	2		
GEOL 332L	Introduction to GIS Lab (BIOL, ENVS)	1		
GEOL 375	Global Positioning Systems for GIS	2		
GEOL 375L	Global Positioning Systems for GIS Lab	1		
GEOL 432	Advanced GIS	2		
GEOL 432L	Advanced GIS Lab	1		
GEOL 445	Geospatial Database & Design	2		
GEOL 445L	Geospatial Database & Design Lab	1		

COLORADO MESA UNIVERSITY

2012-2013 PETITION/PROGRAM SHEET
Minor: Watershed Science

About This Minor . . .

The minor in watershed science is an interdisciplinary program designed to serve the regional need for scientists with a strong background in water-related issues (e.g., Bureau of Land Management, U.S. Geological Survey, U.S. Forest Service (U.S.F.S.), U.S. Fish and Wildlife Service, and the Colorado Division of Wildlife). Some government agencies, such as the U.S.F.S., are shifting their management organization to focus on watersheds, and this minor supports needs in this area.

The minor complements majors in physical and environmental science and biology by providing students in these fields with certification of focused coursework. Combined with the relevant B.S., plus additional calculus and physics courses, the minor satisfies the federal government's requirements for qualification as a hydrologist. The proximity of Colorado Mesa to the Colorado, Gunnison, and Green Rivers, the drainages of the Colorado National Monument, and the high arroyos create an ideal location for the study of watershed science.

POLICIES:

1. It is your responsibility to determine whether you have met the requirements for your degree. Please see the catalog for a complete list of graduation requirements.
2. You must turn in your "Intent to Graduate" form to the Registrar's Office **by September 15 if you plan to graduate the following May, and by February 15 if you plan to graduate the following December**.
3. This program sheet must be submitted with your graduation planning sheet to your advisor during the **semester prior to the semester of graduation, no later than October 1 for spring graduates, no later than March 1 for fall graduates.**
4. Your advisor will sign and forward the Program Sheet and Graduation Planning Sheet to the Department Head for signature.
5. Finally, the Department Head or the department administrative assistant will take the signed forms to the Registrar's Office. (Students cannot handle the forms once the advisor signs.)
6. If your petition for graduation is denied, it will be your responsibility to reapply for graduation in a subsequent semester. Your "Intent to Graduate" does not automatically move to a later graduation date.
7. NOTE: The semester before graduation, you may be required to take a Major Field Achievement Test (exit exam).

NAME: _____ **STUDENT ID #** _____

LOCAL ADDRESS AND PHONE NUMBER: _____

_____ ( ) _____

I, (Signature)_ _____, hereby certify that I have completed (or will complete) all the courses listed on the Program Sheet. I further certify that the grade listed for those courses is the final course grade received except for the courses in which I am currently enrolled and the courses which I complete next semester. I have indicated the semester in which I will complete these courses.

_____ _____ 20_____
Signature of Watershed Science Advisor Date

_____ _____ 20_____
Signature of Department Head Date

_____ _____ 20_____
Signature of Registrar Date

Students should work closely with a faculty advisor when selecting and scheduling courses prior to registration. See the "Undergraduate Graduation Requirements" in the catalog for additional graduation information.

Minor Requirements:

- At least 33 percent of the credit hours required for the minor must bc in courses numbered 300 or above.
- 2.00 eumulative GPA or higher in the minor is required
- The number of minors a student may receive at Colorado Mesa University shall not exceed two.
- A student must follow the CMU graduation requirements either from 1) the program sheet for the major in effect at the time the student officially declares a major; or 2) a program sheet for the major approved for a year subsequent to the year during which the student offieially declares the major and is approved for the student by the department head. Because a program may have requirements specific to the degree, the student should check with the faculty advisor for additional criteria. It is the student's responsibility to be aware of, and follow, all requirements for the degree being pursued. Any exceptions or substitutions must be approved by the student's faculty advisor and Department Head.

REQUIRED COURSES (18 Semester Hours Minimum)

See the current catalog for a list of courses that fulfill the requirements below.

Course No	Title	Sem.hrs	Grade	Term
GEOL 355	Basic Hydrology	3		
GEOL 455	River Dynamics	3		
GEOL 455L	River Dynamics Lab	1		
ENVS 331	Water Quality	3		
ENVS 331L	Water Quality Lab	1		

Seven semester hours (minimum) from the following:

BIOL* 414	Aquatic Biology	3		
BIOL* 414L	Aquatic Biology Lab	1		
CHEM 300	Environmental Chemistry	4		
ENVS* 312	Soil Science and Sustainability	3		
ENVS* 312L	Soil Science and Sustainability Lab	1		
ENVS 433	Restoration of Aquatic Systems	3		
GEOL 394	Natural Resources of the West	1		
GEOL 402	Applications of Geomorphology	3		
GEOL 402L	Applications of Geomorphology Lab	1		
GEOL* 415	Intro to Ground Water	3		
GEOL* 415L	Intro to Ground Water Lab	1		

*Lecture and lab must be taken together

COLORADO MESA UNIVERSITY

2012-2013 PETITION/PROGRAM SHEET
Degree: Bachelor of Science
Major: Physical Sciences
Concentration: Physics

About This Major . . .

Physics is the study of the universe: what it's made of and how it works, ranging from stars and galaxies to atoms and nuclei and everything in between. Physics forms the foundation of many technical fields including electronics and optics. Physics also features prominently in many of the hottest areas of current research and innovation, such as the multidisciplinary fields of nanotechnology and biophysics.

The physics program serves as a foundation for a wide array of careers. Physics majors from Mesa State have gone on to graduate programs in physics, materials science, aerospace engineering, electrical engineering, and to medical school. They have also gone directly into jobs in engineering, business, and research. Over the last ten years Colorado Mesa physics majors have gone to graduate schools at the University of Colorado Boulder, UC Colorado Springs, the Colorado School of Mines, UNLV, UC at Davis, North Carolina State, and the University of Minnesota.

For more information on what you can do with this major, go to http://www.coloradomesa.edu/career/whatmajor.html.

POLICIES:

1. It is your responsibility to determine whether you have met the requirements for your degree. Please see the Catalog for a complete list of graduation requirements.
2. You must turn in your "Intent to Graduate" form to the Registrar's Office **by September 15 if you plan to graduate the following May, and by February 15 if you plan to graduate the following December.**
3. This program sheet must be submitted with your graduation planning sheet to your advisor during the **semester prior to the semester of graduation, no later than October 1 for spring graduates, no later than March 1 for fall graduates.**
4. Your advisor will sign and forward the Program Sheet and Graduation Planning Sheet to the Department Head for signature.
5. Finally, the Department Head or the department administrative assistant will take the signed forms to the Registrar's Office. (Students cannot handle the forms once the advisor signs.)
6. If your petition for graduation is denied, it will be your responsibility to reapply for graduation in a subsequent semester. Your "Intent to Graduate" does not automatically move to a later graduation date.
7. NOTE: The semester before graduation, you will be required to take a Major Field Achievement Test (exit exam).

NAME: _____ **STUDENT ID #** _____

LOCAL ADDRESS AND PHONE NUMBER: _____

_____ ( ) _____

I, (Signature)_____, hereby certify that I have completed (or will complete) all the courses listed on the Program Sheet. I further certify that the grade lisred for those courses is the final course grade received except for the courses in which I am currently enrolled and the courses which I complete next semester. I have indicated the semester in which I will complete these courses.

_____ _____ 20_____
Signature of Advisor Date

_____ _____ 20_____
Signature of Department Head Date

_____ _____ 20_____
Signature of Registrar Date

Students should work closely with a faculty advisor when selecting and scheduling courses prior to registration.

Degree Requirements:

- 120 semester hours total (A minimum of 28 taken at CMU in no fewer than two semesters).
- 40 upper division credits (A minimum of 15 taken at the 300-400 course levels within the major at CMU).
- 2.00 cumulative GPA or higher in all CMU coursework
- 2.00 cumulative GPA or higher in coursework toward the major content area. A "C" or higher is required in all major courses.
- Pre-collegiate courses (usually numbered below 100) cannot be used for graduation.
- When filling out the program sheet a course can be used only once.
- A student must follow the CMU graduation requirements either from 1) the program sheet for the major in effect at the time the student officially declares a major; or 2) a program sheet for the major approved for a year subsequent to the year during which the student officially declares the major and is approved for the student by the department head. Because a program may have requirements specific to the degree, the student should check with the faculty advisor for additional criteria. It is the student's responsibility to be aware of, and follow, all requirements for the degree being pursued. Any exceptions or substitutions must be approved by the student's faculty advisor and Department Head.
- See the "Undergraduate Graduation Requirements" in the for additional graduation information.

GENERAL EDUCATION REQUIREMENTS (31 semester hours)
See the current catalog for a list of courses that fulfill the requirements below. If a course is on the general education list of options and a requirement for your major, you must use it to fulfill the major requirement and make a different selection within the general education requirement.

Course No	Title	Sem.hrs	Grade	Term/Trns
English (6 semester hours, must receive a grade of "C" or better and must be completed by the time the student has 60 semester hours.)				
ENGL 111	English Composition	3		
ENGL 112	English Composition	3		
Math: (3 semester hours, must receive a grade of "C" or better, must be completed by the time the student has 60 semester hours.)				
MATH 151	Calculus I	5*		
*3 credits apply to the General Ed requirements and 2 credits apply to elective credit				
Humanities (3 semester hours)				
Social and Behavioral Sciences (6 semester hours)				
Natural Sciences (7 semester hours, one course must include a lab)				
	L			
History (3 semester hours)				
HIST				
Fine Arts (3 semester hours)				

Course No	Title	Sem.hrs	Grade	Term/Trns
OTHER LOWER DIVISION REQUIREMENTS (6 semester hours)				
Kinesiology (3 semester hours)				
KINE 100	Health and Wellness	1		
KINA 1		1		
KINA 1		1		
Applied Studies (3 semester hours)				
PHYSICAL SCIENCES – PHYSICS MAJOR REQUIREMENTS (60 semester hours) Must pass all courses with a grade of "C" or higher.				
PHYS 131	Fundamental Mechanics	4		
PHYS 131L	Fundamental Mechanics Lab	1		
PHYS 132	Electromagnetism and Optics	4		
PHYS 132L	Electromagnetism and Opties Lab	1		
PHYS 230	Intermediate Dynamics	3		
PHYS 231	Modern Physics	3		
PHYS 251	Electronies for Scientists	3		
PHYS 252	Intermediate Lab	2		
PHYS 311	Electromagnetic Theory I	3		
PHYS 321	Quantum Theory	3		
PHYS 331	Advanced Laboratory I	2		
PHYS 342	Advaneed Dynamics	3		
PHYS 362	Statistical & Thermal Physics	3		
PHYS 422	Quantum Theory II	3		
PHYS 473	Modern Optics	3		
PHYS 482	Senior Research	1		
PHYS 482	Senior Research	1		
PHYS 494	Seminar	1		
PHYS 494	Seminar	1		
(PHYS 482 and 494 are taken twice)				
MATH 152	Calculus II	5		
MATH 253	Calculus III	4		
MATH 260	Differential Equations	3		
MATH 360	Methods of Applied Mathematics	3		
ELECTIVES (All college level courses appearing on your final transcript, **not listed above** that will bring your total semester hours to 120 hours.) (23 semester hours; 13 hours upper division may be needed.)				
*MATH 151	Calculus I	2		

SUGGESTED COURSE SEQUENCING FOR A MAJOR IN PHYSICAL SCIENCE - PHYSICS

This is a suggested sequence of course work. Certain courses may have prerequisites or are only offered during the Fall or Spring semesters. It is the student's responsibility to meet with the assigned advisor and check the 2 year course matrix on the Colorado Mesa website for course availability.

FRESHMAN YEAR

Fall Semester		Hours
PHYS 131	Fundamental Mechanics	4
PHYS 131L	Fundamental Mechanics Lab	1
MATH 151	Calculus I	5
ENGL 111	English Composition	3
General Education	Applied Studies	3
		16

Spring Semester		Hours
PHYS 132	Electromagnetism and Optics	4
PHYS 132L	Electromagnetism and Optics Lab	1
MATH 152	Calculus II	5
ENGL 112	English Composition	3
General Education	History	3
		16

SOPHOMORE YEAR

Fall Semester		Hours
PHYS 230	Intermediate Dynamics	3
PHYS 251	Electronics for Scientists	3
MATH 253	Calculus III	4
General Education	Natural Science	3
KINE 100	Health and Wellness	1
KINA	Activity	1
		15

Spring Semester		Hours
PHYS 231	Modern Physics	3
PHYS 252	Intermediate Lab	2
MATH 260	Differential Equations	3
General Education	Social/Behavioral Science	3
General Education	Humanities	3
KINA	Activity	1
		15

JUNIOR YEAR

Fall Semester		Hours
PHYS 311	Electromagnetic Theory I	3
PHYS 321	Quantum Theory I	3
PHYS 331	Advanced Laboratory	2
MATH 360	Methods of Applied Mathematics	3
General Education	Fine Arts	3
		14

Spring Semester		Hours
PHYS 342	Advanced Dynamics	3
PHYS 362	Statistical and Thermal Physics	3
General Education	Social/Behavioral Science	3
General Education	Natural Science with lab	4
Electives	(unrestricted)	3
		16

SENIOR YEAR

Fall Semester		Hours
PHYS 473	Modern Optics	3
PHYS 482	Senior Research	1
PHYS 494	Seminar	1
Electives	(unrestricted)	9
		14

Spring Semester		Hours
PHYS 422	Quantum Theory II	3
PHYS 482	Senior Research	1
PHYS 494	Seminar	1
Electives	(unrestricted)	9
		14

COLORADO MESA UNIVERSITY

2012-2013 PETITION/PROGRAM SHEET
Degree: Associate of Science
Major: Liberal Arts
Emphasis: Physics

About This Emphasis . . .

The Associate of Science (A.S.) degree is designed for students who intend to continue their education and obtain a baccalaureate degree. The A.S. is the appropriate choice for students who will take upper division coursework in mathematics, biological sciences, and physical sciences. The degree program includes the Colorado Statewide General Education Core and meets the lower division general education requirements at most public institutions in Colorado. A number of emphases are available within the A.S. degree. Students choosing one of these emphases will take courses in a discipline in addition to the general education core.

Physics is the study of the universe: what it's made of and how it works, ranging from stars and galaxies to atoms and nuclei and everything in between. Physics forms the foundation of many technical fields including electronics and optics. Physics also features prominently in many of the hottest areas of current research and innovation, such as the multidisciplinary fields of nanotechnology and biophysics.

Students who continue on in the physics baccalaureate program have a wide array of options. Physics majors from Colorado Mesa have gone on to graduate programs in physics, materials science, aerospace engineering, electrical engineering and to medical school. They have also gone directly into jobs in engineering, business, and research. Over the last ten years, Colorado Mesa physics majors have gone to graduate schools at the University of Colorado Boulder, UC Colorado Springs, the Colorado School of Mines, UNLV, UC at Davis, North Carolina State and the University of Minnesota.

For more information on what you can do with this major, go to http://www.coloradomesa.edu/career/whatmajor.html.

POLICIES:

1. It is your responsibility to determine whether you have met the requirements for your degree. Please see the catalog for a complete list of graduation requirements.
2. You must turn in your "Intent to Graduate" form to the Registrar's Office **by September 15 if you plan to graduate the following May, and by February 15 if you plan to graduate the following December.**
3. This program sheet must be submitted with your graduation planning sheet to your advisor during the **semester prior to the semester of graduation, no later than October 1 for spring graduates, no later than March 1 for fall graduates.**
4. Your advisor will sign and forward the Program Sheet and Graduation Planning Sheet to the Department Head for signature.
5. Finally, the Department Head or the department administrative assistant will take the signed forms to the Registrar's Office. (Students cannot handle the forms once the advisor signs.)
6. If your petition for graduation is denied, it will be your responsibility to reapply for graduation in a subsequent semester. Your "Intent to Graduate" does not automatically move to a later graduation date.
7. NOTE: The semester before graduation, you may be required to take a Major Field Achievement Test (exit exam).

NAME: _____ **STUDENT ID #** _____

LOCAL ADDRESS AND PHONE NUMBER: _____

_____ ( ) _____

I, (Signature)_____, hereby certify that I have completed (or will complete) all the courses listed on the Program Sheet. I further certify that the grade listed for those courses is the final course grade received except for the courses in which I am currently enrolled and the courses which I complete next semester. I have indicated the semester in which I will complete these courses.

_____ _____ 20_____
Signature of Advisor Date

_____ _____ 20_____
Signature of Department Head Date

_____ _____ 20_____
Signature of Registrar Date

Stndents should work closely with a faculty advisor when selecting and scheduling courses prior to registration.

Degree Requirements:

- 60 semester hours total (A minimum of 16 taken at CMU in no fewer than two semesters).
- 2.00 cumulative GPA or higher in all CMU courscwork and a gradc point average of 2.5 or higher must bc carned in thc Physics arca of emphasis.
- Pre-collegiatc courses (usually numbered below 100) cannot be used for graduation.
- No more than one "D" may be used in completing major requiremcnts.
- A grade of "C" or higher must be earned in all general education courscs in order to be acccpted for thc transfer under the Core Transfer Agreements.
- A student must follow the CMU graduation requirements either from 1) the program sheet for the major in effcet at the time the student offieially declares a major; or 2) a program shect for the major approved for a year subsequent to the year during which the student officially declares the major and is approved for the student by the department head. Because a program may have requirements specific to the degree, the student should check with the faculty advisor for additional criteria. It is the student's responsibility to be aware of, and follow, all requircments for the dcgree bcing pursued. Any exceptions or substitutions must be approved by the studcnt's faculty advisor and Department Head.
- When filling out the program sheet a course can be used only once.
- See the "Undergraduate Graduation Requirements" in the catalog for additional graduation information.

GENERAL EDUCATION REQUIREMENTS (31 semester hours)
See the current catalog for a list of courses that fulfill the requirements below. If a course is on the general education list of options and a requirement for your major, you must use it to fulfill the major requirement and make a different selection within the general education requirement.

Course No	Title	Sem.hrs	Grade	Term/Trns

English (6 semester hours, must rceeivc a grade of "C" or better and must be completed by the time the student has 60 semcster hours.)

ENGL 111	English Composition	3		
ENGL 112	English Composition	3		

Math: MATH 151 (3 semester hours, must receive a grade of "C" or better, must be completed by the time the student has 60 semester hours.)

MATH 151	Calculus I	5*		

*3 crcdits apply to the General Ed requirements and 2 credits apply to elective credit

Humanities (3 semester hours)

Course No	Title	Sem.hrs	Grade	Term/Trns

Social and Behavioral Sciences (6 semester hours)

Course No	Title	Sem.hrs	Grade	Term/Trns

Natural Sciences (7 semester hours, one course must include a lab)

Course No	Title	Sem.hrs	Grade	Term/Trns
	L			

History (3 semester hours)

Course No	Title	Sem.hrs	Grade	Term/Trns
HIST				

Fine Arts (3 semester hours)

Course No	Title	Sem.hrs	Grade	Term/Trns

OTHER LOWER DIVISION REQUIRMENTS (5 semester hours)

Kinesiology (2 semester hours)

KINE 100	Health and Wellness	1		
KINA 1		1		

Applied Studies (3 semester hours)

Course No	Title	Sem.hrs	Grade	Term/Trns

PHYSICS EMPHASIS REQUIREMENTS (24 semester hours)

Core Classes (13 semester hours)

PHYS 131	Fundamental Mechanics	4		
PHYS 131L	Fundamental Mechanics Lab	1		
PHYS 132	Electromagnetism & Optics	4		
PHYS 132L	Electromagnetism & Optics Lab	1		

Choose **either** PHYS 230 Intermediate Dynamics OR PHYS 231 Modern Physics

PHYS 3				

Physics Specialization Classes (11 Semester Hours)

*MATH 151	Calculus I	2		
MATH 152	Calculus II	5		
MATH 253	Calculus III	4		

SUGGESTED COURSE SEQUENCING FOR THE ASSOCIATE OF SCIENCE WITH A MAJOR IN LIBERAL ARTS - EMPHASIS IN PHYSICS

This is a suggested sequence of course work. Certain courses may have prerequisites or are only offered during the Fall or Spring semesters. It is the student's responsibility to meet with the assigned advisor and check the 2 year course matrix on the Colorado Mesa website for course availability.

FRESHMAN YEAR

Fall Semester		Hours
PHYS 131	Fundamental Mechanics	4
PHYS 131L	Fundamental Mechanics Lab	1
ENGL 111	English Composition	3
MATH 151	Calculus I	5
General Education	History	3
		16

Spring Semester		Hours
PHYS 132	Electromagnetism and Optics	4
PHYS 132L	Electromagnetism and Optics Lab	1
ENGL 112	English Composition	3
MATH 152	Calculus II	5
General Education	Humanities	3
		16

SOPHOMORE YEAR

Fall Semester		Hours
PHYS 230	Intermediate Dynamics OR	
General Education	Applied Studies	3
MATH 253	Calculus III	4
General Education	Natural Science	4
General Education	Social/Behavioral Science	3
		14

Spring Semester		Hours
PHYS 231	Modern Physics OR	
General Education	Applied Studies	3
General Education	Fine Arts	3
General Education	Natural Science	3
General Education	Social/Behavioral Science	3
KINE 100	Health and Wellness	1
KINA	Activity	1
		14

COLORADO MESA UNIVERSITY

2012-2013 PETITION/PROGRAM SHEET
Minor: Physics

About This Minor . . .

Physics is the study of the universe: what it is made of and how it works, ranging from stars and galaxies to atoms and nuclei and everything in between. Physics forms the foundation of many technical fields, including electronics and optics. Physics features prominently in many of the hottest areas of current research and innovation, such as the multidisciplinary fields of nanotechnology and biophysics.

A physics minor is a good complement to a mathematics, chemistry, geology, environmental science, or biology major.

POLICIES:

1. It is your responsibility to determine whether you have met the requirements for your degree. Please see the catalog for a complete list of graduation requirements.
2. You must turn in your "Intent to Graduate" form to the Registrar's Office **by September 15 if you plan to graduate the following May, and by February 15 if you plan to graduate the following Deeember**.
3. This program sheet must be submitted with your graduation planning sheet to your advisor during the **semester prior to the semester of graduation, no later than October 1 for spring graduates, no later than March 1 for fall graduates.**
4. Your advisor will sign and forward the Program Sheet and Graduation Planning Sheet to the Department Head for signature.
5. Finally, the Department Head or the department administrative assistant will take the signed forms to the Registrar's Office. (Students cannot handle the forms once the advisor signs.)
6. If your petition for graduation is denied, it will be your responsibility to reapply for graduation in a subsequent semester. Your "Intent to Graduatc" does not automatically move to a later graduation date.
7. NOTE: The scmester before graduation, you may be required to take a Major Field Achievement Test (exit exam).

NAME: _____ **STUDENT ID #** _____

LOCAL ADDRESS AND PHONE NUMBER: _____

_____ ( ) _____

I, (Signature) _____, hereby certify that I have completed (or will complete) all the courses listed on the Program Sheet. I further certify that the grade listed for those courses is the final course grade received except for the courses in which I am currently enrolled and the courses which I complete next semester. I have indicated the semester in which I will complete these courses.

_____ _____ 20_____
Signature of Physics Advisor Date

_____ _____ 20_____
Signature of Department Head Date

_____ _____ 20_____
Signature of Registrar Date

Students should work closely with a faculty advisor when selecting and scheduling courses prior to registration. See the "Undergraduate Graduation Requirements" in the catalog for additional graduation information.

Minor Requirements:

- At least 33 percent of the credit hours required for the minor must be in courses numbered 300 or above.
- 2.00 cumulative GPA or higher in the minor is required
- The number of minors a student may receive at Colorado Mesa University shall not exceed two.
- A student must follow the CMU graduation requirements either from 1) the program sheet for the major in effect at the time the student officially declares a major; or 2) a program sheet for the major approved for a year subsequent to the year during which the student officially declares the major and is approved for the student by the department head. Because a program may have requirements specifie to the degree, the student should check with the faculty advisor for additional criteria. It is the student's responsibility to be aware of, and follow, all requirements for the degree being pursued. Any exceptions or substitutions must be approved by the student's faculty advisor and Department Head.

REQUIRED COURSES (20 Semester Hours)

Course No	Title	Sem.hrs	Grade	Term/Trns
PHYS 131	Fundamental Mechanics	4		
PHYS 131L	Fundamental Mechanics Lab	1		
PHYS 132	Electromagnetism & Optics	4		
PHYS 132L	Electromagnetism & Optics Lab	1		
Choose **either** PHYS 230 Intermediate Dynamics **OR** PHYS 231 Modern Physics				
PHYS ___	_____	3		
PHYS 494	Seminar	1		

Course No	Title	Sem.hrs	Grade	Term/Trns
Upper Division Physics Elective				
___ ___	_____	3		
Choose one of the following:				
PHYS ___	_____	3		
PHYS 311	Electromagnetic Theory I	3		
PHYS 321	Quantum Theory	3		
PHYS 362	Statistieal & Thermal Physics	3		
PHYS 342	Advanced Dynamics	3		

Appendix II

Annual Data on Enrollment, Credit Hours, Majors, Graduates, and Faculty

Number of Students Declared as Majors

Program	Degree	Code	Major	2007-08		2008-09		2009-10		2010-11		2011-12	
				1st Major	All	1st Major	All	1st Major	All	1st Major	All	1st Major	All
	BS	3490	Undeclared Nat Science/Math	14	21	3	14	7	19	5	16	2	14
Subtotal				14	21	3	14	7	19	5	16	2	14
Chemistry	PB	2951	Chemistry Prov Bacc							1	1	2	2
	BS	3465	Chemistry	41	51	34	38	53	67	55	68	54	69
Subtotal				41	51	34	38	53	67	56	69	56	71
Geology	Cert	1770	Geographic Info Science	2	5	1	4	5	9	6	8	4	6
	AS	2431	Liberal Arts, Geology	11	14	13	22	19	24	23	27	27	33
	PB	2953	Geology Prov Bacc							2	2	6	6
	BS	3401	Geology, Pre-Teacher Ed									2	2
		3460	Geology	33	37	47	51	46	49	53	57	62	64
		3461	Geology, Teacher Certification		1		1	3	3	5	5	2	2
		3462	Geology, Environmental	11	12	8	10	7	11	15	21	17	25
Subtotal				57	69	69	88	80	96	104	120	120	138
Physics	AS	2433	Liberal Arts, Physics	7	8	11	14	10	13	9	11	10	16
	BS	3463	Physics	23	25	28	33	29	32	31	36	27	33
		3464	Physics, Teacher Certification	2	5								
Subtotal				32	38	39	47	39	45	40	47	37	49
Grand Total				130	158	142	173	172	208	200	236	213	258

Number of Students Declared as Minors

Code	Minor	2007-08	2008-09	2009-10	2010-11	2011-12
Chemistry	M410	18	24	19	14	18
Geographic Information Science	M752	8	9	7	8	9
Geology	M420	1	1	1	4	4
Physics	M430	4	1	3	7	7
Watershed Science	M470	8	6	8	7	11
Grand Total		39	41	38	40	49

Number of Degrees Awarded

Program	Degree	Code	Major	2007-08		2008-09		2009-10		2010-11		2011-12	
				1st Major	All	1st Major	All	1st Major	All	1st Major	All	1st Major	All
Chemistry	BS	3465	Chemistry	3	3			5	5	4	4	4	4
Subtotal				3	3			5	5	4	4	4	4
Geology	Cert	1770	Geographic Info Science	10	10	4	4	3	3	4	4	2	2
	AS	2431	Liberal Arts, Geology	1	1	4	4	2	2	1	1	2	2
	BS	3460	Geology	4	4	8	8	2	2	11	12	2	2
		3462	Geology, Environmental	2	2	1	1	1	1	1	2	1	1
Subtotal				17	17	17	17	8	8	17	19	7	7
Physics	AS	2433	Liberal Arts, Physics	1	1					1	1	1	1
	BS	3463	Physics	3	3	4	4	5	5	2	2	5	5
Subtotal				4	4	4	4	5	5	3	3	26	26
Grand Total			Total BS Grads	12	12	13	13	13	13	18	20	12	12
			Total AS Grads	2	2	4	4	2	2	2	2	3	3
			Total Cert Grads	10	10	4	4	3	3	4	4	2	2

Number of Minors and Certificates Awarded

Code	Minor	2007-08		2008-09		2009-10		2010-11		2011-12	
		1st Minor	All	1st Minor	All	1st Minor	All	1st Minor	All	1st Minor	All
M410	Chemistry	3	5	7	9	5	5	3	4	4	4
M420	Geology										
M430	Physics	1	1			1	1	1	1	1	2
M470	Watershed Science	2	2	2	2	2	3	3	4	3	4
M752	Geographic Info Science	3	3	3	3	2	2	4	5	1	1
	Grand Total	9	11	12	14	10	11	11	14	9	11

Student Credit Hours by Student Level

Subject	Student Level	2007-08 Enrolled	2007-08 SCH	2008-09 Enrolled	2008-09 SCH	2009-10 Enrolled	2009-10 SCH	2010-11 Enrolled	2010-11 SCH	2011-12 Enrolled	2011-12 SCH
CHEM	FR	134	348	121	320	153	391	170	435	327	826
	SO	234	610	251	653	365	935	351	921	425	1111
	JR	213	545	183	488	255	672	276	718	324	856
	SR	344	887	381	996	367	993	457	1176	531	1415
	Non-Deg	17	44	14	36	27	69	9	23	7	17
	PBL	8	20	6	14	4	10	14	37	11	28
CHEM Total		950	2454	956	2507	1171	3070	1277	3310	1625	4253
GEOL	FR	424	1151	383	1040	763	2102	932	2569	900	2478
	SO	509	1288	500	1278	596	1535	802	2108	882	2326
	JR	221	540	174	442	262	672	265	668	326	812
	SR	371	827	319	716	365	812	400	913	490	1104
	Grad									1	3
	Non-Deg	16	44	29	76	27	66	36	105	10	25
	PBL	11	25	15	28	10	19	2	4	1	3
GEOL Total		1552	3875	1420	3580	2023	5206	2437	6367	2610	6751
PHYS	FR	181	533	190	547	334	950	329	946	290	818
	SO	246	697	257	723	360	985	389	1072	397	1079
	JR	118	324	163	445	184	492	241	649	279	739
	SR	310	818	314	794	279	723	346	880	311	801
	Grad							2	5		
	Non-Deg	12	34	16	44	16	45	32	90	9	22
	PBL	4	11	5	13	8	24	6	18	2	5
PHYS Total		871	2417	945	2566	1181	3219	1345	3660	1288	3464

(continued)

Student Credit Hours by Student Level (continued)

Total	FR	808	2239	753	2080	1387	3852	1576	4377	1735	4761
	SO	1090	2861	1115	2940	1528	4016	1767	4724	1961	5224
	JR	623	1584	620	1612	804	2086	935	2440	1143	2943
	SR	1145	2818	1214	2948	1322	3260	1545	3728	1726	4242
	Grad							3	8	1	3
	Non-Deg	71	194	83	223	73	187	80	227	29	71
	PBL	35	86	39	80	25	60	23	60	15	39
Grand Total		3373	8746	3321	8653	4375	11495	5059	13337	5523	14468

Student Credit Hours by Course Level

		2007-08		2008-09		2009-10		2010-11		2011-12	
Subject	Course Level	Enrolled	SCH	Enrolled	SCH	Enrolled	SCH	Enrolled	SCH	Enrolled	SCH
CHEM	100	763	1984	722	1914	942	2491	1032	2718	1332	3505
	200	24	48	34	68	25	51	28	56	39	79
	300	159	411	188	501	196	504	202	505	243	636
	400	4	11	12	24	8	24	15	31	11	33
CHEM Total		950	2454	956	2507	1171	3070	1277	3310	1625	4253
GEOL	100	1254	3274	1186	3102	1708	4600	2105	5679	2214	5930
	200	45	135	33	99	30	90	52	156	53	159
	300	170	313	120	216	170	294	161	294	192	360
	400	83	153	81	163	115	222	119	238	151	302
GEOL Total		1552	3875	1420	3580	2023	5206	2437	6367	2610	6751
PHYS	100	792	2208	842	2329	1091	2989	1227	3367	1191	3217
	200	22	63	27	74	17	51	56	160	25	75
	300	37	106	33	92	45	135	37	100	44	124
	400	20	40	43	71	28	44	25	33	28	48
PHYS Total		871	2417	945	2566	1181	3219	1345	3660	1288	3464
Total	100	3014	8054	2938	7891	4090	11123	4741	12877	5196	14001
	200	129	324	166	379	213	519	332	862	320	812
	300	497	1135	540	1251	595	1320	624	1362	783	1823
	400	132	269	180	362	241	499	232	463	311	647
Grand Total		3373	8746	3321	8653	4375	11495	5059	13337	5523	14468

Credit Hour Production by Course

Course	Title	Cr Hr	2007-08			2008-09			2009-10			2010-11			2011-12			5-Year Average		
			Sec-tions	En-rolled	SCH	Sec-tions	En-rolled	SCH	Sec-tions	En-rolled	SCH	Sec-tions	En-rolled	SCH	Sec-tions	En-rolled	SCH	Sec-tions	En-rolled	SCH
CHEM																				
100	Chemistry & Society-GTSC1	3	3	102	306	3	104	312	3	113	339	3	120	360	3	122	366	3	112	337
121	Principles of Chemistry-GTSC1	4	3	129	516	3	115	460	3	119	476	4	169	676	5	216	864	4	150	598
121L	Prin of Chem Lab-GTSC1	1	5	117	117	5	110	110	5	112	112	7	156	156	10	207	207	6	140	140
122	Principles/Org Chem-GTSC1	4	1	14	56													1	14	56
122L	Prin/Org Chem Lab-GTSC1	1	2	12	12													2	12	12
123	Intro to Enviro Chemistry	4				1	18	72	1	17	68	1	21	84	1	24	96	1	20	80
131	General Chemistry-GTSC1	4	2	128	512	2	115	460	3	219	876	3	180	720	4	271	1084	3	183	730
131L	General Chemistry Lab-GTSC1	1	5	124	124	6	106	106	8	200	200	7	165	165	11	249	249	7	169	169
132	General Chemistry-GTSC1	4	2	68	272	3	80	320	2	86	344	2	112	448	3	132	528	2	96	382
132L	General Chemistry Lab-GTSC1	1	4	69	69	4	74	74	4	76	76	5	109	109	6	111	111	5	88	88
211	Quantitative Analysis	3	1	12	36	1	17	51	1	13	39	1	14	42	1	20	60	1	15	46
211L	Quantitative Analysis Lab	1	2	12	12	2	17	17	2	12	12	2	14	14	2	19	19	2	15	15
300	Environmental Chemistry	4				1	10	40							1	16	64	1	13	52
311	Organic Chemistry	4	1	41	164	1	45	180	1	41	164	1	45	180	1	51	204	1	45	178
311L	Organic Chemistry Lab	1	2	34	34	2	38	38	2	34	34	2	41	41	2	43	43	2	38	38
312	Organic Chemistry	4	1	27	108	1	33	132	1	36	144	1	32	128	1	37	148	1	33	132
312L	Organic Chemistry Lab	1	2	24	24	2	28	28	2	29	29	2	30	30	2	34	34	2	29	29
315	Biochemistry	3	1	15	45	1	15	45	1	19	57	1	20	60	1	20	60	1	18	53
315L	Biochemistry Laboratory	1	1	2	2	1	4	4	1	8	8	1	10	10	1	8	8	1	6	6
321	Physical Chemistry I	3	1	3	9	1	6	18	1	8	24	1	6	18	1	9	27	1	6	19
322	Physical Chemistry II	3	1	3	9	1	2	6	1	9	27	1	8	24	1	7	21	1	6	17
341	Advanced Laboratory I	2	1	2	4	1	3	6	1	5	10	1	2	4	1	8	16	1	4	8
397	Structured Research	1-3	4	8	12	2	4	4	4	7	7	6	8	10	6	10	11	4	7	9
411	Main Group Elements	3							1	8	24							1	8	24

421	Adv. Organic Chemistry I	3	2	3	9									1	5	15	2	4	12
431	Instrumental Analysis	3				1	6	18				1	8	24				1	7	21
431L	Instrumental Analysis Lab	1				1	6	6				1	7	7				1	7	7
482	Senior Research I	2	1	1	2													1	1	2
496	Topics	3													1	6	18	1	6	18
CHEM Total			48	950	2454	46	956	2507	48	1171	3070	54	1277	3310	66	1625	4253	52	1196	3119

			2007-08			2008-09			2009-10			2010-11			2011-12			5-Year Average		
Course	Title	Cr Hr	Sec-tions	En-rolled	SCH	Sec-tions	En-rolled	SCH	Sec-tions	En-rolled	SCH	Sec-tions	En-rolled	SCH	Sec-tions	En-rolled	SCH	Sec-tions	En-rolled	SCH
GEOL																				
100	Survey of Earth Science-GTSC2	3	5	144	432	5	117	351	5	185	555	5	284	852	6	254	762	5	197	590
103	Weather and Climate-GTSC2	3	4	194	582	4	181	543	4	306	918	4	381	1143	4	350	1050	4	282	847
104	Oceanography-GT-SC-2	3	3	172	516	3	166	498	4	307	921	4	369	1107	4	319	957	4	267	800
105	Geology of Colorado-GTSC2	3	4	139	417	4	153	459	4	248	744	4	298	894	4	255	765	4	219	656
106	Intro to Dinosaurs-GT-SC2	3	2	58	174	2	68	204	2	78	234	2	76	228	2	77	231	2	71	214
107	Nat Haz & Env Geology-GTSC2	3	2	57	171	2	46	138	2	53	159	2	52	156	6	243	729	3	90	271
111	Prin of Physical Geology-GTSC1	3	8	202	606	6	172	516	5	200	600	6	254	762	6	284	852	6	222	667
111L	Prin of Physical Geo Lab-GTSC1	1	11	199	199	9	173	173	9	194	194	11	243	243	13	280	280	11	218	218
112	Prin of Historical Geol-GTSC1	3	2	17	51	2	20	60	2	24	72	2	31	93	2	35	105	2	25	76
112L	Prin of Hist Geol Lab-GTSC1	1	2	18	18	2	20	20	2	23	23	2	33	33	2	35	35	2	26	26
113	F-Based Intro Phys Geo-GTSC1	3	2	27	81	2	35	105	2	45	135	2	42	126	2	41	123	2	38	114
113L	Fld-Based Phys Geol Lab-GTSC1	1	2	27	27	2	35	35	2	45	45	2	42	42	2	41	41	2	38	38
202	Introduction to Field Studies	3	2	18	54	2	13	39	2	18	54	2	22	66	2	21	63	2	18	55
204	Computer Appl in Geology	3	2	17	51	2	16	48	2	12	36	2	15	45	2	18	54	2	16	47
250	Environmental Geology	3	1	10	30	1	4	12				1	15	45	1	14	42	1	11	32
301	Structural Geology	3	1	11	33	1	6	18	1	16	48	1	7	21	1	18	54	1	12	35
301L	Structural Geology Lab	1	1	11	11	1	6	6	1	16	16	1	7	7	1	18	18	1	12	12
305	Cartography for GIS	1	1	16	16	1	11	11	1	21	21	1	11	11	1	10	10	1	14	14

321	Intro Remote Sensing	2	1	5	10	1	7	14	1	9	18	1	7	14	1	8	16	1	7	14
321L	Intro Remote Sensing Lab	1	1	5	5	1	7	7	1	9	9	1	7	7	1	8	8	1	7	7
331	Crystallography/Mineralogy	3	1	11	33	1	7	21	1	6	18	1	11	33	1	12	36	1	9	28
331L	Crystal/Mineral Lab	1	1	10	10	1	7	7	1	6	6	1	11	11	1	12	12	1	9	9
332	Intro to GIS (x-listed)	2	2	12	24	2	11	22	2	19	38	2	11	22	2	22	44	2	15	30
332L	Intro to GIS Lab(x-listed)	1	2	12	12	2	11	11	2	19	19	2	11	11	2	22	22	2	15	15
333	Geology of the Canyon Country	1	1	8	8	1	8	8	1	8	8	1	14	14	1	11	11	1	10	10
340	Igneous/Metamorph Petrology	3	1	8	24	1	10	30	1	7	21	1	9	27	1	10	30	1	9	26
340L	Ign/Metamorph Petro Lab	1	1	8	8	1	9	9	1	6	6	1	9	9	1	10	10	1	8	8
355	Basic Hydrology	3	1	15	45	1	7	21	1	8	24	1	24	72	1	14	42	1	14	41
359	Surv Energy-Rel Nat Resour	3				1	9	27	1	4	12				1	11	33	1	8	24
370	Renewable Energy	3													1	5	15	1	5	15
375	GPS for GIS	2	1	7	14	1	3	6	1	8	16	1	10	20	1	6	12	1	7	14
375L	GPS for GIS Lab	1	1	7	7	1	3	3	1	8	8	1	11	11	1	6	6	1	7	7
394	Natural Resources of the West	1										1	10	10	1	5	5	1	8	8
396	Topics	1-3	3	29	61	1	4	4	2	12	24	1	5	15				2	13	26
402	Appl of Geomorphology	3				1	9	27	1	5	15	1	9	27	1	11	33	1	9	26
402L	Appl/Geomorphology Lab	1				1	9	9	1	5	5	1	9	9	1	11	11	1	9	9
404	Geophysics	3	1	4	12	1	4	12	1	10	30	1	11	33	1	11	33	1	8	24
404L	Geophysics Laboratory	1	1	4	4	1	4	4	1	10	10	1	11	11	1	11	11	1	8	8
415	Introduction to Ground Water	3	1	5	15				1	8	24				1	10	30	1	8	23
415L	Intro Ground Water Lab	1	1	5	5				1	8	8				1	10	10	1	8	8
432	Advanced GIS	2	1	8	16	1	4	8	1	6	12	1	6	12	2	11	22	1	7	14
432L	Advanced GIS Lab	1	1	8	8	1	4	4	1	6	6	1	6	6	2	11	11	1	7	7
444	Sedimentology & Stratigraphy	3	1	15	45	1	5	15	1	12	36	1	6	18	1	17	51	1	11	33
444L	Sediment/Stratigraphy Lab	1	1	15	15	1	5	5	1	12	12	1	6	6	1	17	17	1	11	11
445	Geodatabase Design	2	1	6	12	1	4	8	1	9	18	1	5	10	1	3	6	1	5	11
445L	Geodatabase Lab	1	1	6	6	1	4	4	1	9	9	1	5	5	1	3	3	1	5	5
455	River Dynamics	3				1	7	21				1	14	42				1	11	32

455L	River Dynamics Laboratory	1				1	7	7				1	14	14				1	11	11
490	Seminar	3	1	3	9	1	4	12	1	8	24	1	7	21	1	4	12	1	5	16
493	Co-operative Education	3				2	2	6				1	1	3	1	1	3	1	1	4
495	Independent Study	3													1	1	3	1	1	3
497	Structured Research	1-3	3	4	6	6	9	21	6	7	13	6	9	21	9	19	46	6	10	21
GEOL Total			86	1557	3883	88	1426	3589	86	2035	5224	90	2451	6388	104	2626	6775	91	2019	5172

			2007-08			2008-09			2009-10			2010-11			2011-12			5-Year Average		
Course	Title	Cr Hr	Sec-tions	En-rolled	SCH	Sec-tions	En-rolled	SCH	Sec-tions	En-rolled	SCH	Sec-tions	En-rolled	SCH	Sec-tions	En-rolled	SCH	Sec-tions	En-rolled	SCH
PHYS																				
100	Concepts of Physics-GTSC2	3	7	151	453	6	162	486	6	198	594	4	253	759	5	220	660	6	197	590
101	Elementary Astronomy-GTSC2	3	4	260	780	4	226	678	4	289	867	4	262	786	4	193	579	4	246	738
111	General Physics-GTSC1	4	3	112	448	3	124	496	3	126	504	4	157	628	5	178	712	4	139	558
111L	General Physics Lab-GTSC1	1	6	103	103	6	114	114	7	116	116	7	146	146	9	168	168	7	129	129
112	General Physics-GTSC1	4	1	51	204	1	55	220	2	56	224	2	77	308	2	81	324	2	64	256
112L	General Physics Lab-GTSC1	1	3	49	49	3	52	52	3	58	58	4	73	73	4	79	79	3	62	62
131	Fundamental Mechanics-GTSC1	4	1	17	68	1	35	140	2	73	292	2	87	348	3	83	332	2	59	236
131L	Fundamental Mech Lab-GTSC1	1	1	15	15	2	30	30	4	70	70	5	79	79	4	75	75	3	54	54
132	Electromagnetism/Optics-GTSC1	4	1	18	72	1	23	92	2	53	212	2	49	196	2	58	232	2	40	161
132L	Electromagn/Optics Lab-GTSC1	1	1	16	16	2	21	21	3	52	52	3	44	44	3	56	56	2	38	38
230	Intermediate Dynamics	3							1	2	6	1	13	39	1	6	18	1	7	21
231	Modern Physics	3	1	6	18	1	8	24	1	13	39	1	29	87	1	19	57	1	15	45
232	Modern Physics II	3	1	6	18	1	6	18										1	6	18
251	Electronics for Scientists	3	1	7	21	1	6	18	1	2	6	1	6	18				1	5	16
252	Intermediate Laboratory	2	1	3	6	1	7	14				1	8	16				1	6	12
301	Intro Space Science	3	1	7	21				1	7	21	1	7	21	1	7	21	1	7	21
311	Electromagnetic Theory	3	1	7	21	1	5	15	1	4	12	1	4	12	1	7	21	1	5	16
312	Electromagnetic Theory II	3													1	4	12	1	4	12

321	Quantum Theory I	3	1	6	18	1	7	21	1	6	18	1	1	3	1	9	27	1	6	17
331	Advanced Laboratory I	2	1	3	6	1	7	14				1	3	6	1	6	12	1	5	10
342	Advanced Dynamics	3	1	6	18	1	6	18	1	7	21	1	4	12	1	3	9	1	5	16
362	Statistical/Thermal Physics	3	1	3	9	1	4	12	1	6	18				1	7	21	1	5	15
395	Independent Study	1-2	1	2	4							1	4	4	1	1	1	1	2	3
396	Topics	3	1	3	9	1	4	12	2	15	45	1	14	42				1	9	27
422	Quantum Theory II	3	1	3	9	1	5	15	1	5	15				1	7	21	1	5	15
473	Modern Optics	3	1	5	15	1	8	24	1	3	9	1	4	12	1	3	9	1	5	14
482	Senior Research	1	2	5	5	2	15	15	2	10	10	2	10	10	2	8	8	2	10	10
494	Seminar	1	1	5	5	2	13	13	2	9	9	2	11	11	2	9	9	2	9	9
495	Independent Study	1-3	2	2	6	1	1	1	1	1	1				1	1	1	1	1	2
496	Topics	3				1	1	3										1	1	3
PHYS Total			47	871	2417	47	945	2566	53	1181	3219	53	1345	3660	58	1288	3464	52	1126	3065
Grand Total			181	3378	8754	181	3327	8662	187	4387	11513	197	5073	13358	228	5539	14492	195	4341	1135

Credit Hours by Faculty Type

		2007-08			2008-09			2009-10			2010-11			2011-12		
Subject	Faculty Type	CCH	SCH	% SCH	CCH	SCH	% SCH	CCH	SCH	% SCH	CCH	SCH	% SCH	CCH	SCH	% SCH
CHEM	1 -T/TT	73	1508	61%	51	1265	50%	47	1536	50%	70	2094	63%	84	2649	62%
	3 -FT NonTT	22	853	35%	43	1142	46%	43	1346	44%	22	830	25%	21	728	17%
	5 -Admin/Coaches	2	45	2%	2	40	2%	2	38	1%	3	70	2%	3	51	1%
	6 -PT	3	48	2%	3	60	2%	6	150	5%	14	316	10%	26	825	19%
CHEM Total		100	2454	100%	99	2507	100%	98	3070	100%	109	3310	100%	134	4253	100%
GEOL	1 -T/TT	114	1458	38%	137	1499	42%	123	1910	37%	130	2275	36%	151	2984	44%
	3 -FT NonTT	63	2269	58%	48	1790	50%	48	2815	54%	48	3525	55%	48	3153	47%
	5 -Admin/Coaches	1	20	1%	3	51	1%	3	55	1%	3	56	1%	3	68	1%
	6 -PT	10	136	4%	9	249	7%	12	444	8%	17	532	8%	26	570	8%
GEOL Total		188	3883	100%	197	3589	100%	186	5224	100%	198	6388	100%	228	6775	100%
PHYS	1 -T/TT	83	1202	50%	68	1295	50%	80	1528	47%	84	2042	56%	105	2755	80%
	3 -FT NonTT	24	1119	46%	27	981	38%	12	639	20%	28	1461	40%	25	643	19%
	6 -PT	9	96	4%	14	290	11%	32	1052	33%	7	157	4%	3	66	2%
PHYS Total		116	2417	100%	109	2566	100%	124	3219	100%	119	3660	100%	133	3464	100%
Total	1 -T/TT	357	5172	53%	339	5098	52%	349	6446	48%	402	8355	54%	492	10860	63%
	3 -FT NonTT	109	4241	43%	118	3913	40%	106	4848	36%	98	5816	37%	94	4524	26%
	5 -Admin/Coaches	3	65	1%	5	91	1%	5	93	1%	6	126	1%	6	119	1%
	6 -PT	26	304	3%	39	781	8%	78	2074	15%	57	1267	8%	82	1780	10%
Grand Total		404	8754	3	405	8662	3	408	11513	3	426	13358	3	495	14492	3

Ratio of full-time equivalent students (FTES) to Full-time equivalent faculty (FTEF)

	2007-08			2008-09			2009-10			2010-11			2011-12		
Subject	FTES	FTEF	FTES:FTEF	FTES	FTEF	FTES:FTEF	FTES	FTEF	FTES:FTEF	FTES	FTEF	FTES:FTEF	FTES	FTEF	FTES:FTEF
CHEM	81.8	4.2	19.6	83.6	4.1	20.3	102.3	4.1	25.1	110.3	4.5	24.3	141.8	5.6	25.4
GEOL	129.4	7.8	16.5	119.6	8.2	14.6	174.1	7.8	22.5	212.9	8.3	25.8	225.8	9.5	23.8
PHYS	80.6	4.8	16.7	85.5	4.5	18.8	107.3	5.2	20.8	122.0	5.0	24.6	115.5	5.5	20.8
Grand Total	291.8	16.8	17.4	288.7	16.8	17.2	383.7	17.1	22.4	445.2	17.8	25.0	483.1	20.6	23.5

Appendix III

Faculty Curriculum Vitae

Full-Time Faculty, Fall 2006 to Spring 2012

Chemistry

Joe Richards	Ph.D.	1995-present	Tenured
Craig Dodson	Ph.D.	1995-2008	Tenured
James Ayers	Ph.D.	2007-present	Tenure-track
Tim D'Andrea	Ph.D.	2008-present	Tenure-track
David Weinberg	Ph.D.	2011-present	Tenure-track
Sue Kenney	M.S.	2006-present	Temporary

Geology

Verner Johnson	Ph.D.	1984-present	Tenured
Rex Cole	Ph.D.	1995-present	Tenured
Rick Livaccari	Ph.D.	1997-present	Tenured
Andres Aslan	Ph.D.	1999-present	Tenured
Gigi Richard	Ph.D.	2002-present	Tenured
Harold Hase	M.S.	1992-present	Temporary
Donn Lorhammer	M.S.	2006-present	Temporary

Physics

Bill Tiernan	Ph.D.	1997-present	Tenured
David Collins	Ph.D.	2006-present	Tenure-track
Chad Middleton	Ph.D.	2006-present	Tenure-track
Jared Workman	Ph.D.	2011-present	Tenure-track
Alexander Gurshtein	Ph.D.	2001-2010	Temporary
Andy Shiekh	Ph.D.	2010-present	Temporary

Name:

James D Ayers

Start Year: 2003

Program:
Physical Sciences

Department:
Physical and Environmental Sciences

COLORADO MESA UNIVERSITY

Full-time Faculty Vita

Faculty Rank

○ Professor ○ Assistant Professor

◉ Associate Professor ○ Instructor

Highest Degree

PhD	Stanford University	Chemistry	Year

Education: (List all degrees beginning with most recent-include post docs and external certificates)

Postdoctoral Scholar, Department of Chemistry and Biochemistry and Geophysical Institute, University of Alaska Fairbanks, 2003-2005

Ph.D., Chemistry, Stanford University, 2003

B.S., Physics, University of Texas at Austin, 19998

Teaching 2003-Present:

Courses Taught

CHEM 121/121L, Principles of Chemistry with lab
CHEM 131/131L, General Chemistry I with lab
CHEM 132/132L, General Chemistry II with lab
CHEM 300, Environmental Chemistry
CHEM 321, Physical Chemistry I
CHEM 322, Physical Chemistry II
CHEM 341, Advanced Lab
CHEM 397, Structured Research
SUPP 101, Introduction to Higher Education

Evidence of Continuous Improvement

SUPP 101 training course, May 2010
SUPP 101 training course, May 2009

Innovative Materials/Activities

Developed Lab materials for CHEM 131L/132L

Supervision of Student Research/Project(s)

Fall 2011- One student working on calibration curve for ClO4
Fall 2010 - One student working on ClO4
Spring 2010 - One student working on snow major ions baseline project
Fall 2007-Spring 2008 - One student working on snow major ions baseline project

Scholarship and Creative Work, 2003-Present:

Scholarship Related to Discipline

Journal Articles

J. D. Ayers and W. R. Simpson. "Measurements of N_2O_5 near Fairbanks, Alaska." *Journal of Geophysical Research Atmospheres* **111**, D14309, doi:10.1029/2006JD007070, (2006).

J.D. Ayers, R. L. Apodaca, W. R. Simpson, and D. S. Baer. "Off-axis cavity ringdown spectroscopy: application

to atmospheric nitrate radical detection." *Applied Optics* **44,** 7239-7242 (33), (2005).

J. D. Ayers, A. E. Pomerantz, F. Fernández-Alonso, F. Ausfelder, B. D. Bean, and R. N. Zare. "Measurement of the cross section for $H+D_2 \rightarrow HD(v' =3,j' =0)+D$ as a function of angle and energy," *Journal of Chemical Physics* **119** (9), 4662-4670 (2003).

Conference Presentation

J. D. Ayers and W. R. Simpson. Measurements of NO_3 and N_2O_5 in the Polluted Subarctic Atmosphere: A Seasonal Perspective From Multi-year Observations in Fairbanks, AK. Poster presented at the Fall American Geophysical Union meeting, San Francisco, CA, December 2004.

J. D. Ayers, A. E. Pomerantz, F. Ausfelder, F. Fernández-Alonso, B. D. Bean, and R. N. Zare. Experimental Cross Section for $H + D_2 \rightarrow HD(v'=3,j'=0) + D$ as a Function of Angle and Energy. Poster presented at the 50_{th} Western Spectroscopy Association Conference, Asilomar, CA, January 2003.

Other

Reviewer for 5 grant proposals, Department of Energy Small Business Innovation Research

Professional Memberships

American Geophysical Union (2003-present)

Service 2003-Present:

University

2011

Curriculum Committee Representative, PES

Faculty-to-Faculty Representative, Chemistry

HLC Criterion 1 Commitee Member

2010

Curriculum Committee Representative, PES

Faculty-to-Faculty Representative, Chemistry

Asessment Committee Representative, PES (spring only)

2009

NSSEE Evaluation Committee Representative, PES

2008

Department

2011

Program Coordinator, Chemistry

Chair, Inorganic Chemistry Search Committee

Member, Chemistry Laboratory Coordinator Search Committee

Member, Biochemistry Search Committee

2010

Program Coordinator, Chemistry

Chair, Inorganic Chemistry Search Committee

2009

Program Coordinator, Chemistry (summer and fall)

Chair, Analytical Chemistry Search Committee

PES Faculty Evaluation Review Committee

2008

Chair, Analytical Chemistry Search Committee

Community

National

2011

Exam Author, US National Chemistry Olympiad

2010

Exam Author, US National Chemistry Olympiad

2009
Exam Author, US National Chemistry Olympiad
2008
Exam Author, US National Chemistry Olympiad

Local
2008
Judge, Western Slope Science Fair.
Chemistry demonstration, Western Slope Science Fair Awards Ceremony
Chemistry demonstration, Plateau Valley High School

Advising 2003-Present:

University level
2011
SOAR sessions (1)
2010
SOAR sessions (1)
2009
SOAR sessions (3)
2008
SOAR sessions (2)

Department level
2008-2011 Served as faculty advisor for 10-30 students

Honors and Awards 2003-Present:

Professional Experience:

Please record the number "items/events" you have listed above in the following categories.
If you specify items/events under "other," please provide an explanation/definition.

	Books	**Book Reviews**		**Creative Publications**	
3	**Journal Articles**	**Performances**		**Patents**	
2	**Conference Presentations**	**Exhibitions**	0	**Grants-funded and non-funded**	
	Sabbaticals	**Fullbright**		**Book Chapter**	
5	**Other (related to discipline)**	Reviewer for grant proposals			

Name:

Timothy Michael D'Andrea

Start Year: 2009

Program:
Physical Sciences

Department:
Physical and Environmental Sciences

COLORADO MESA UNIVERSITY

Full-time Faculty Vita

Faculty Rank

○ Professor ◉ Assistant Professor

○ Associate Professor ○ Instructor

Highest Degree

PhD	University of Colorado, Boulder	Chemistry	2008

Education: (List all degrees beginning with most recent-include post docs and external certificates)

Ph. D. Chemistry and Biochemistry~Summer 2008

B.S. Chemistry, *summa cum laude*~Spring 2003

Teaching 2003-Present:

Courses Taught

CHEM 131, General Chemistry 1
CHEM 131L, General Chemistry 1 Lab
CHEM 132, General Chemistry 2
CHEM 132L, General Chemistry 2 Lab
CHEM 211, Quantitative Analysis
CHEM 211L, Quantitative Analysis Lab
CHEM 322, Physical Chemistry 2
CHEM 397, Structured Research
CHEM 411, Main Group Elements
CHEM 431, Instrumental Analysis
CHEM 431L, Instrumental Analysis Lab

Evidence of Continuous Improvement

2011: Added a new two week atomic spectroscopy lab to the CHEM 211L curriculum.
2010: Rewrote all of the CHEM 132 labs. Most of the labs were similar to ones previously performed at CMU; however, several new experiments were added.
2009: Rewrote all of the CHEM 131 labs. Most of the labs were similar to ones previously performed at CMU; however, several new experiments were added.

Innovative Materials/Activities

2011: Created a two week inquiry based lab experiment for CHEM 431L.
2010: Implemented an atoms first approach to General Chemistry. This required a complete overhaul of the curriculum. Added an exciting synthetic lab (synthesis of nylon and oil of wintergreen) to CHEM 131L.
2009: Introduced i-clickers into General Chemistry curriculum.

Supervision of Student Research/Project(s)

2011: Supervised 2 research students in the lab
2010: Supervised 5 research students in the lab
2009:Supervised 2 research students in the lab

A description of the research can be seen below under "Unpublished Research"

Scholarship and Creative Work, 2003-Present:
Scholarship Related to Discipline

Journal Articles:
Timothy M. D'Andrea, Xu Zhang, Evan B. Jochnowitz, T.G. Lindeman, C.J.S.M. Simpson, Don David, Tom Curtiss, John R. Morris, G. Barney Ellison. Oxidation of Organic Films by Beams of Hydroxyl Radicals. *J. Phys. Chem. B*; 2008; 112(2) pp 535 - 544.

Conference Presentations:
Summer 2007
"Oxidation of Organic Films by Beams of Hydroxyl Radicals" presented at the 62nd International Symposium on Molecular Spectroscopy. Ohio State University, Columbus, OH

Other
Seminar talks:
Spring 2009
"The Physics of Heterogeneous Chemistry and the Applications to Our Atmosphere" to be presented at the Physics Colloquium. Mesa State College, Grand Junction, CO
Spring 2008
"Oxidation of Organic Films by Beams of Hydroxyl Radicals" presented at the Gas Phase Ion Chemistry Seminar. University of Colorado, Boulder, CO
Fall 2007
Presented the methods used to create clean and intense molecular beams of hydroxyl radicals and reactively scatter them off the surface of thin films at Methods in Chemistry Seminar. University of Colorado, Boulder, CO
Fall 2005
Presented the methods used to study the matrix isolation Fourier-Transform Infrared Spectroscopy of reactive intermediates at Methods in Chemistry Seminar. University of Colorado, Boulder, CO

Scholarship Related to Pedagogy in Discipline

Conference Presentation
Spring 2007
"Interactive Student Learning is Just a Click Away" presented at the First-Year International Chemistry Conference. Boulder, CO

Creative Work Related to Discipline

Publications
Timothy M. D'Andrea, Xu Zhang, Evan B. Jochnowitz, T.G. Lindeman, C.J.S.M. Simpson, Don David, Tom Curtiss, John R. Morris, G. Barney Ellison. Oxidation of Organic Films by Beams of Hydroxyl Radicals. *J. Phys. Chem. B*; 2008; 112(2) pp 535 - 544.

Other:
Grants:
April 21, 2010
NSF MRI Grant Submitted as P.I., $139,572, **MRI: Acquisition of a pyrolysis gas chromatograph/mass spectrometer at Mesa State College**
August 10, 2009
NSF MRI2 Grant Submitted as P.I., $144,983, **MRI-R2: Acquisition of a pyrolysis gas chromatograph/mass spectrometer at Mesa State College**

Unpublished research
2009-2011: CHEM397, Structured Research
Worked closely with five research students over this time. Much of our work is getting older analytical equipment

functioning properly and using this equipment to analyze complex mixtures. Specifically, we are working with a local business, Kannah Creek, attempting to understand some of the chemistry that takes place during their brewing process. The samples are difficult to analyze because they are complex mixtures of numerous chemical species. In addition, we are attempting to quantify trace small amounts of specific chemicals.

Service 2003-Present:

University

2011:
Library committee member
Early Scholars chemistry coordinator
Participated in Exploring a Major Fair (Oct 11)
Performed demonstrations for new marketing commercials
2010:
Library committee member
Early Scholars chemistry coordinator
Participated in MavScholar event (Sept 9)
Participated in Mesa State Experience program (Oct 9)
2009:
Library committee member
Early Scholars chemistry coordinator
Participated in Mesa State Experience program (Oct 3)

Department

2011:
Chair of Chemistry lab coordinator search committee
Member of two chemistry faculty searches
2010:
Member of chemistry faculty search committee
Hosted speaker from CU-Boulder to give a seminar on renewable energy
Member of physical science committee for disabled students in the lab/field
2009:
Member of physical science committee for disabled students in the lab/field

Community

National
2010:
Participated in survey conducted by the Educational Policy Improvement Center

Regional
2011:
Regional science fair junior finals judge
2010:
Regional science fair junior finals judge
2009:
Regional science fair junior finals judge

Local
2010:
Helped middle school student perform lab tests for her science fair project

Advising 2003-Present:

University level

2011:
Participated in SOAR session (July 2011)

2010:
Participated in SOAR session (Summer 2010)
2009:
Participated in SOAR session (Summer 2009)
Department level
2011:
Advised approximately 25 students
Submitted approximately 20 letters of recommendation
Participated in a chemistry game night to advise incoming chemistry majors (Sept 7)
2010:
Advised approximately 30 students
Submitted approximately 12 letters of recommendation
2009:
Advised approximately 15 students
Submitted a few letters of recommendation

Honors and Awards 2003-Present:

Professional Experience:

Please record the number "items/events" you have listed above in the following categories.
If you specify items/events under "other," please provide an explanation/definition.

	Books	**Book Reviews**	1	**Creative Publications**	
1	**Journal Articles**	**Performances**		**Patents**	
2	**Conference Presentations**	**Exhibitions**	2	**Grants-funded and non-funded**	
	Sabbaticals	**Fullbright**		**Book Chapter**	
4	**Other (related to discipline)**	Seminar talks			

Name:

Joseph L Richards

Start Year: 1995

Program:
Physical Sciences

Department:
Physical and Environmental Sciences

COLORADO MESA UNIVERSITY

Full-time Faculty Vita

Faculty Rank

(•) Professor ( ) Assistant Professor

( ) Associate Professor ( ) Instructor

Highest Degree

PhD	University of North Carolina at Chapel Hill	Organic Chemistry	1991

Education: (List all degrees beginning with most recent-include post docs and external certificates)
Postdoctoral Fellow, University of California, San Diego (1991-1993)
Ph.D. (Organic Chemistry), University of North Carolina, Chapel Hill (1991)
B.A. (Chemistry and Biology), University of San Diego (1986)

Teaching 2003-Present:
Courses Taught

CHEM 121 (Principles of Chemistry)
CHEM 122 (Principles of Organic Chemistry)
CHEM 311 (Organic Chemistry I)
CHEM 311L (Organic Chemistry Laboratory I)
CHEM 312 (Organic Chemistry II)
CHEM 312L (Organic Chemistry Laboratory II)
CHEM 315 (Biochemistry)
CHEM 315L (Biochemistry Laboratory)
CHEM 341 (Advanced Laboratory)
CHEM 397 (Structured Research)
CHEM 421 (Advanced Organic Chemistry)
CHEM 482 (Senior Research I)
CHEM 483 (Senior Research II)

Supervision of Student Research/Project(s)

Approximately 30 students have participated in my ongoing research projects over the last decade. Most of these involved the continuation of projects aimed at synthesizing natural products found to be involved in plant defense mechanisms.

Scholarship and Creative Work, 2003-Present:

Journal Articles

Inter- and Intraspecific Comparisons of Antiherbivore Defenses in Three Species of Rainforest Understory Shrubs, R. M. Fincher, L. A. Dyer, C. D. Dodson, J. L. Richards, M. A. Tobler, J. Searcy, J. E. Mather, A. J. Reid, J. S. Rolig, and W. Pidcock, J. Chem. Ecol., 34, 558 -574 (2008).

Book Chapters

Isolation, Synthesis, and Evolutionary Ecology of Piper amides, Lee A. Dyer, Joe Richards, and Craig D. Dodson, in Piper A Model Genus for Studies of Phytochemistry, Ecology, and Evolution, Dyer and Palmer, Eds., Kluwer Academic/Plenum Publishers (2004).

Grants

National Science Foundation, $154,792 (Pending)
Collaborative Research: Antiherbivore Synergy Between and Within Iridoid Glycosides, Saponins, and Piper Imides
Joseph L. Richards

National Science Foundation, $126,000 (Awarded 2007)
Collaborative Research: Mixture Synergy in Piper Imides, Iridoid Glycosides, and Furanocoumarins
Craig D. Dodson and Joseph L. Richards

National Science Foundation, $69,685 (Awarded 2004)
Collaborative Research: Plant Secondary Metabolites as Mediators of Trophic Interactions in a Tropical Forest Community
Craig Dodson and Joseph L. Richards

Sabbaticals
Sabbatical Leave Granted (2009-2010)

Professional Memberships

American Chemical Society - Member (Organic and Inorganic Division)
National Scientific Association - Advisory/Editorial Board
Service 2003-Present:
University
2003
School of Natural Sciences and Mathematics Tenure Committee - PES representative
School of Natural Sciences and Mathematics Promotion Committee - PES representative
Educational Access Services Committee - NSM representative
Faculty Salary and Benefits Committee - NSM representative
2004
MSC Curriculum Committee - PES Representative
MSC Faculty Salary and Benefits Committee - PES representative
School of Natural Sciences and Mathematics Tenure Committee - PES representative
School of Natural Sciences and Mathematics Promotion Committee - PES representative
Educational Access Services Committee - NSM/PES representative
Member of campus committee charged with consolidating and writing new faculty handbook
Marshall for 2004 commencement ceremonies
2005
MSC Curriculum Committee - PES representative and Chair (Served without release time!)
MSC Faculty Salary and Benefits Committee - PES representative
General Education Work Group - CC/PES representative
Educational Access Services Committee - PES representative
2006
MSC Curriculum Committee - Chair
MSC Faculty Salary and Benefits Committee - PES representative
General Education Working Group - CC/PES representative
Merit Pay Working group - PES representative
Faculty Panel on Teaching Effectiveness for New Faculty - Panel Member
Educational Access Services Committee - PES representative
2007
MSC Curriculum Committee - Chair
MSC Distance Learning and Technology Committee
MSC Tenure and Promotion Committee
MSC Merit Pay Working Group
MSC Educational Access Services Committee
2008
MSC Faculty Senate - Active PES Representative

MSC Distance Learning and Technology Committee - Active PES Representative
MSC Tenure and Promotion Committee - Active PES Representative
MSC Educational Access Services Committee - Active PES Representative
2009-2010
MSC Faculty Senate - Active PES Representative
MSC Distance Learning and Technology Committee - PES Representative
MSC Tenure and Promotion Committee - PES Representative
MSC Educational Access Services Committee - PES Representative
ISEP Advisory Board - Member
2011
Acting Department Head - PES
HLC Accreditation Steering Committee - Co-Chair
ISEP Advisory Board - Member
Educational Access Services Committee - PES representative

Department
2003
Chemistry Search Committee - Member
Faculty Advisor for a Student Affiliate Chapter of the American Chemical Society
2004
Member of PES committee charged with developing criteria for faculty evaluation.
Chemistry Search Committee - Member/Chair
Faculty Advisor for a Student Affiliate Chapter of the American Chemical Society
2007
PES Tenure and Promotion Advisory Committee
PES Chemistry Unit Coordinator
PES Chemistry Search Committee
2008
PES Tenure and Promotion Advisory Committee - Active Member
PES Chemistry Unit Coordinator
PES Analytical Chemistry Search Committee - Active Member
Prepared presentation for the MavsScholars Preview Event
2009-2010
PES Tenure and Promotion Advisory Committee - Member
PES Chemistry Unit Coordinator
PES Analytical Chemistry Search Committee - Member
2011
Chemistry Search Committee - Chair

All Years
Provided significant maintenance on instruments
Provided many sets of recommendation letters and verbal recommendations for many students

Community
2003
Senior Finals Judge at the Western Colorado Science Fair
2005
Primary Judge at Bookcliff Christian School Science Fair
2006
Organized judging at Bookcliff Christian School Science Fair
2007
Organized judging at Bookcliff Christian School Science Fair

Advising 2003-Present:

PES representative at a variety of incoming student preview events
Faculty Advisor for the Student Affiliate Chapter of the American Chemical Society at MSC
Advisor to Chemistry majors each semester

Honors and Awards 2003-Present:

Mesa County Outstanding Educator of the Year (2006)

Mesa State College Distinguished faculty Award - Teaching (2004)

Professional Experience:

Please record the number "items/events" you have listed above in the following categories.
If you specify items/events under "other," please provide an explanation/definition.

	Books	**Book Reviews**		**Creative Publications**
1	**Journal Articles**	**Performances**		**Patents**
	Conference Presentations	**Exhibitions**	3	**Grants-funded and non-funded**
1	**Sabbaticals**	**Fullbright**	1	**Book Chapter**
	Other (related to discipline)			

Name:

David R Weinberg

Start Year: 2011

Program:
Physical Sciences

Department:
Physical and Environmental Sciences

COLORADO MESA UNIVERSITY

Full-time Faculty Vita

Faculty Rank

○ Professor ◉ Assistant Professor

○ Associate Professor ○ Instructor

Highest Degree

PhD	California Institute of Technology	Chemistry	2009

Education: (List all degrees beginning with most recent-include post docs and external certificates)

Postdoctoral Scolar, The University of North Carolina at Chapel Hill, 2008 - 2011

Ph.D., Chemistry, California Institute of Technology, 2009

B. A., Biochemistry Pathway of Chemistry, University of San Diego, 2001

Teaching 2003-Present:
Courses Taught
Chem 131, General Chemistry I

Chem 131L, General Chemistry I Lab

Evidence of Continuous Improvement
Participated in a student/faculty free-for-all discussion organized by Dr. Clare Boulanger which took place on Spetember 19, 2011 and focused on "Teaching and learning: What works for you? What doesn't?"

Innovative Materials/Activities
Chemistry Informational Game Night, September 7th, 2011: I came up with the idea, organized, advertised, and participated in an informational game night, which facilitated faculty discussions with students interested in pursuing a major or minor in chemistry.

Supervision of Student Research/Project(s)
October 10th - December 5th 2011: I worked with two students, one through a work-study program, on finding a new carbon dioxide reduction electrocatalyst that could potentially be implemented into a device for converting carbon dioxide, water, and solar energy into fuels.

Scholarship and Creative Work, 2003-Present:
Scholarship Related to Discipline

Journal Articles
Weinberg, D. R.; Gagliardi, C. J.; Hull, J. F.; Murphy, C. F.; Kent, C. A.; Westlake, B.; Paul, A.; Ess, D. H.; McCafferty, D. G.; Meyer, T. J. "Proton-Coupled Electron Transfer" manuscript submitted to Chemical Reviews.

Zuofeng Chen, Chuncheng Chen, David R. Weinberg, Peng Kang, Javier Concepcion, Daniel P. Harrison, Maurice S. Brookhart, and Thomas J. Meyer. "Electrochemical reduction of CO_2 to CO by polypyridyl ruthenium complexes" Chemical Communications 2011, 47, 12607 – 12609.

Weinberg, D. R.; Hazari, N.; Labinger, J. A.; Bercaw, J. E. "Iridium(I) and Iridium(III) Complexes Supported by a Diphenolate Imidazolyl-Carbene Ligand" Organometallics 2010, 29, 89-100.

Weinberg, D. R.; Labinger, J. A.; Bercaw, J. E. "The Competitive Oxidation and Protonation of Aqueous Monomethylplatinum(II) Complexes: A Comparison of Oxidants" Organometallics 2007, 26, 167-172.

Soper, J. D.; Saganic, E.; Weinberg, D.; Hrovat, D. A.; Benedict, J. B.; Kaminsky, W.; Mayer, J. M. "Nucleophilic Aromatic Substitution on Aryl-Amido Ligands Promoted by Oxidizing Osmium(IV) Centers" Inorganic Chemistry 2004, 43, 5804-5815.

Conference Presentations
Weinberg, D. R.; Chen, Z.; Shearer, A. J.; Meyer, T. J. "Electrocatalytic Carbon Dioxide Reduction at Thin Polymeric Films Containing Either Pd(0) or Rh(0) Particles." *Abstracts of Papers,* 240th National Meeting of the American Chemical Society, Boston, MA; American Chemical Society: Washington, DC, 2010; INOR 512.

Weinberg, D. R.; Hazari, N.; Labinger, J. A.; Bercaw, J. E. "Synthesis and Characterization of Iridium Complexes Containing a Diphenolate Imidazolyl-Carbene Ligand" *Abstracts of Papers, 238th* National Meeting of the American Chemical Society, Washington, DC; American Chemical Society: Washington, DC, 2009; INOR 266.

Weinberg, D. R.; Labinger, J. A.; Bercaw, J. E. "Homogeneous Platinum-Based Catalysis for Direct Conversion of Methane to Methanol: A Comparison of Potential Oxidants." *Abstracts of Papers,* 8th Natural Gas Conversion Symposium: Natal, Brazil, 2007.

Weinberg, D. R.; Labinger, J. A.; Bercaw, J. E. "Competitive Oxidation and Protonation of Aqueous Monomethylplatinum(II) Complexes: Comparison of Oxidants." *Abstracts of Papers,* 229th National Meeting of the American Chemical Society, San Diego, CA; American Chemical Society: Washington, DC, 2005; INOR 390.

Other:
Grants
"Chelation-Assisted Gold(III) Activation of Strong, sp3-Hybridized C-H Bonds, Similar to Those Found in Alkanes." American Chemical Society Petroleum Research Fund Undergraduate New Investigator Research Grant; September 1, 2012 - August 31, 2014; $50,000. *Submitted in November, 2011.*

Unpublished research
Weinberg, D. R.; Chen, G. S.; Labinger, J. A.; Bercaw, J. E. "Synthesis of Electron-Rich Platinum(II) Complexes Containing the 2,2'-Biindolyl Ligand" *Manuscript in preparation.*

Professional Memberships
American Chemical Society, 2006 - present.

Service 2003-Present:
University
2011:
Stampede Weekend Events: 2

Department
2011:
Chemistry Faculty Search Committee

Chemistry Informational Game Night

Advising 2003-Present:
University level
2011:
Mesa Experience Sessions: 2

Major Fair Sessions: 1

Department level
2011:
Advised 2 - 3 students regarding the medical school application process

Advised 1 student regarding his application to pharmacy schools

Honors and Awards 2003-Present:

Local
2003:
Dow Travel Fellowship, California Institute of Technology

Professional Experience:

Please record the number "items/events" you have listed above in the following categories.
If you specify items/events under "other," please provide an explanation/definition.

	Books	**Book Reviews**		**Creative Publications**	
5	**Journal Articles**	**Performances**		**Patents**	
4	**Conference Presentations**	**Exhibitions**	1	**Grants-funded and non-funded**	
	Sabbaticals	**Fullbright**		**Book Chapter**	
1	**Other (related to discipline)**	manuscript in preparation			

Name:

Suzanne C Kenney

Start Year: 2006

Program:
Physical Sciences

Department:
Physical and Environmental Sciences

COLORADO MESA UNIVERSITY

Full-time Faculty Vita

Faculty Rank

C Professor C Assistant Professor

C Associate Professor ◉ Instructor

Highest Degree

MS	Clarkson University	Civil Engineering	2000

Education: (List all degrees beginning with most recent-include post docs and external certificates)

MS, Civil Engineering, Clarkson University, 2000

BS, Chemical Engineering (Concentration in Mathematics), Clarkson University, 1996

Teaching 2003-Present:
Courses Taught

CHEM100, Chemistry and Society

CHEM121, Principles of Chemistry

CHEM121L, Principles of Chemistry Lab

CHEM123, Environmental Chemistry

CHEM132L, General Chemistry 2 Lab

Evidence of Continuous Improvement

April 29-30, 2010: Kathryn Ley, University of Houston - Clear Lake
Improving Online Communications Quality
Helping Online Students Learn and You Teach

January 14 - 15, 2010: Patricia Phelps, University of Central Arkansas
Restoring the Joy in Teaching
Ways to Promote Learning

April 30 - May 1, 2009: Keith Bailey, Pennsylvania State University
Thinking about Online Learning
Rethinking Your Current Design and Delivery Approach
Quality Assessment of Online Courses
Strategizing Your ROI for Online Learning

January 15 - 16, 2009: Barbara Millis, University of Nevada - Las Vegas
Using Groups and Academic Games for Learning and Assessment
Course Redesign Revitalization

May 1 - 2, 2008: Ed Neal, University of North Carolina
Designing Courses that Promote Critical Thinking

Teaching Critical Thinking: Active Learning
Evaluating Critical Thinking
Classroom Management: Dealing with Difficulties

May 2007: FYI Chemistry Conference (ICUC sponsored): First-Year Undergraduate Chemistry Education International Conference; Global Communication for a Sustainable World, University of Colorado at Boulder, 2007.

May 3 - 4, 2007: Linda Nilson, Clemson University
Reaching the 75% of the Students Who Don't Do the Readings
My Top 10: The Worst Teaching Practices I've Ever Seen
Fast but Fair Methods to Grade Writing
A Self-Directed Guide to Designing Courses for Significant Learning

Scholarship and Creative Work, 2003-Present:

Professional Memberships
American Chemical Society (2004 - 2010)

Service 2003-Present:

Department

Search Committee Member - Chemical Stockroom Director (2011)

Advising 2003-Present:

Honors and Awards 2003-Present:
National

Regional

Local

Professional Experience:

Saint Lawrence University (2004 - 2006): Chemical Stockroom Director, Chemical Hygiene Officer, Radiation Safety Officer, Hazardous Waste Manager

Alcoa (2002-2004): Senior Process Engineer

Corning Inc. (1998 - 2001): Senior Process Engineer, Process Engineer

Eastman Kodak (Fall 1994, Summer 1995, Summer 1996): Engineer Intern

Please record the number "items/events" you have listed above in the following categories.
If you specify items/events under "other," please provide an explanation/definition.

0	**Books**	0	**Book Reviews**	0	**Creative Publications**
0	**Journal Articles**	0	**Performances**	0	**Patents**
0	**Conference Presentations**	0	**Exhibitions**	0	**Grants-funded and non-funded**
0	**Sabbaticals**	0	**Fullbright**	0	**Book Chapter**
0	**Other (related to discipline)**				

Name:

Andres Aslan

Start Year: 1999

Program:
Physical Sciences

Department:
Physical and Environmental Sciences

COLORADO MESA UNIVERSITY

Full-time Faculty Vita

Faculty Rank

(•) Professor ( ) Assistant Professor

( ) Associate Professor ( ) Instructor

Highest Degree

PhD	Institution University of Colorado	Discipline Geology	Year 1994

Education: (List all degrees beginning with most recent-include post docs and external certificates)
Ph.D. Geology (1994) University of Colorado-Boulder
M.S. Geology (1990) University of Colorado-Boulder
B.S. Geology (1986) Brown University

Teaching 2003-Present:
Courses Taught
GEOL 111/111L Physical Geology
GEOL 107 Natural Hazards
GEOL 202 Introduction to Field Methods
ENVS 312/312L Soil Properties and Characterization
GEOL 380 Field Camp
GEOL 402/402L Geomorphology
GEOL 490 Senior Seminar

Innovative Materials/Activities
2011-2003 Western Slope Field Conference Field Trip - students in GEOL 202 and 402 attend this regional field trip annually
2010, 2009- Friends of the Pleistocene Field Conference - students in GEOL 402 attend this regional field conference and interact with students and professors from all over the U.S.
2011, 2009 - Field seminar with Dave Noe, Colorado Geological Survey, GEOL 402

Supervision of Student Research/Project(s)
* Winner of CMU Student Showcase award
2011* - Geoff Warden, Dendrochronology and Historical Changes along the Colorado River Floodplain
2011 - Bryan Richards, Fluvial terraces of the Yampa River valley
2011-Tyler Kruckenberg, Correlation of Rifle and Grand Mesa terraces
2011 - William Walsh, Origins of Crowner Fm. deposits in the Yampa Valley
2011- Trish Hyatt, Origin of granite clasts in fluvial deposits of the Uncompahgre Plateau
2010 - Greg Indivero, Distribution of Browns Park Fm deposits in northwestern Colorado
2010 - Beau Taylor, Evaluation of paleoaltimetry methods
2010 - Marc Gorenc, Paleodrainages of the Park and Gore Ranges
2010 - Courtney Goff, Cenozoic uplift of the San Juan Mountains
2010* - Zach Logan, Ancient river gravels of the Uncompahgre Plateau
2009 - Dustin Czapla, Ancient Colorado River gravels beneath Grand Mesa
2008- Carl McIntyre, Ancient river gravels of the Uncompahgre Plateau
2008 - Andy Darling, Use of Lava Creek B ash to constrain the ages of Uncompahgre & Gunnison River terraces, Delta, CO
2008* - Anne Hayden, Arroyo history of Douglas Creek

2008 - Mary Benage, Use of heavy minerals to evaluate provenance of the Cactus Park lake beds
2007 - Anne Hayden, Arroyo history of Sieber Canyon, Uncompahgre Plateau
2005 - Alex Garhart, Cactus Park lake beds
2005- Charlie Knowles, Cactus Park river gravels
2005- John Quigley, Mapping of Colorado River gravels in Grand Junction
2004 - Michele Neslson, John Hodge - Sieber Canyon alluvial stratigraphy
2003 - Pam Riddle, Robert Wilson, Emilie Quist, Influence of dust on soil development, western Colorado

Scholarship and Creative Work, 2003-Present:

Scholarship Related to Discipline

Journal Articles

Karlstrom, K.E., Coblentz, D., Dueker, K Ouimet, W., Kirby, E., Van Wijk, J., Schmandt, B., Kelley, S., Lazear, G., Crossey, L.J., Crow, R., **Aslan, A.**, Darling, A., Aster, R., MacCarthy, J., Hansen, J., Stachnik, J., and the CREST working group (in press, Lithosphere). Mantle-driven dynamic uplift of the Rocky Mountains and Colorado Plateau and its surface response: toward a unified hypothesis.

Aslan, A., Karlstrom, K.E., Crossey, L.J., Kelley, S., **Cole, R.**, Lazear, G., and **Darling, A.** 2010. Late Cenozoic evolution of the Colorado Rockies: Evidence for Neogene uplift and drainage integration, in Morgan, L.A., and Quane, S.L., eds., Through the Generations: Geologic and Anthropogenic Field Excursions in the Rocky Mountains from Modern to Ancient: Geological Society of America Field Guide 18, p. 21-54.

Darling, A., Karlstrom, K., **Aslan, A., Cole, R.D.,** Betton, C., and Wan, E. 2009. Quaternary incision rates and drainage evolution of the Uncompahgre and Gunnison Rivers, western Colorado, as calibrated by the Lava Creek B ash. Rocky Mountain Geology, v. 44, p. 71-83.

Hood, W.C., **Cole, R.D., and Aslan, A.** 2009. Anomalous cold in the Pangaean Tropics. Geology - Comment, v. 37, p. 192.

Aslan, A., Karlstrom, K., Hood, W., **Cole, R.D.**, Oesleby, T., Betton, C., Sandoval, M., **Darling, A., Kelley, S., Hudson, A., Kaproth, B., Schoepfer, S., Benage, M., Landman, R.** 2008. River incision histories of the Black Canyon of the Gunnison and Unaweep Canyon: Interplay between late Cenozoic tectonism, climate change, and drainage integration in the western Rocky Mountains, In Raynolds, R.G. (ed.), Roaming the Rocky Mountains and Environs: Geological Society of American Field Guide 10, p. 175-202.

Aslan, A., Autin, W.J., Blum, M.D., 2006, Reply to Comment - Late Holocene Avulsion History of the Mississippi River, south Louisiana, U.S.A. Journal of Sedimentary Research, v. 76, p. 960.

Aslan, A., Autin, W.J., Blum, M.D., 2005, Late Holocene Avulsion History of the Mississippi River, south Louisiana, U.S.A. Journal of Sedimentary Research, v. 75, p. 648-662.

Aslan, A., White, W.A., Warne, A.G., and Guevara, E.H. 2003. Holocene Evolution of the western Orinoco Delta, Venezuela. Geological Society of America Bulletin, v. 115, p. 479-498.

Conference Presentation

Aslan, A., Karlstrom, K., Kirby, E., Rosenberg, R., and **Darling, A.** 2011. Late Cenozoic river incision rates from the Colorado Rockies and implications for Neogene uplift. Geological Society of America Meeting, Minneapolis, MN

Warden, G. and **Aslan, A.**, 2011.Possible connections between historic (1880-1940 A.D.) arroyo cutting and floodplain changes along the Colorado River in western Colorado. Geological Society of America, Rocky Mt Section Meeting, Logan, Utah

Aslan, A., Karlstrom, K., Kirby, E., Lazear, G., Ouimet, W., Kelley, S., **Darling, A.**, and Heizler, M. 2010. Post-10 MA River Incision Rates in western Colorado: Implications for Neogene uplift of the Colorado Rockies. Geological Society of America Meeting, Denver, CO

Aslan, A. and Hanson, P. 2009. Late Pleistocene Colorado River terraces, western Colorado: a test of the stream power model. Geological Society of America Meeting, Portland, OR

Czapla, D. and **Aslan, A.** 2009. Evidence of a Miocene Ancestral Colorado River, Western Colorado. Geological Society of America, Rocky Mt Section Meeting, Salt Lake City, UT

Aslan, A., Hood, W., Karlstrom, K., Kirby, E., Granger, D., Betton, C., **Darling, A.**, **Benage, M., Schoepfer, S.** 2008. Abandonment of Unaweep Canyon ~1 Ma and the effects of transient knickpoint migration, western Colorado. Geological Society of America Meeting, Houson, TX

Hayden, A., Aslan, A., and Hanson, P. 2008. Douglas Creek revisited - evidence for climate-driven arroyo incision in western Colorado. Geological Society of America Meeting, Houston, TX

Darling, A. Karlstrom, K., Kirby, E., Ouimet, W., Cobblentz, D., and **Aslan, A.** 2008. Evaluating Neogene uplift and denudational history of the Colorado Rockies using river profiles and incision records. EOS trans., AGU, 89(53), Fall Meeting Suppl., Abstract T11C-1893.

Karlstrom, K., Kirby, E., Kelley, S., **Aslan, A.,** Ouimet, W., Cobblentz, D., van Wijk, J. 2008. Colorado River system of the southwestern U.S.: Analysis of the longitudinal profile, differential incision, and hypothesis for dynamic uplift and rapid incision in the last 6 Ma. EOS trans., AGU, 89(53), Fall Meeting Suppl., Abstract T11C-1896.

Aslan, A. and Kirkham, R.K. 2007. Origin of the upper Colorado River system: the view from western Colorado. Geological Society of America Meeting, Denver, CO

Karlstrom, K.E., Kirby, E., Kelley, S., **Aslan, A.,** Sandoval, M.M., and Crow, R. 2007. Neotectonic influences on the longitudinal profile of the Colorado River system in Grand Canyon and the Rocky Mountains. Geological Society of America Meeting Denver, CO

Brown, E., Grant, D., Pendleton, M., and **Aslan, A.** 2007. Incision history of the Colorado River in western Colorado and its implications for climate vs. tectonic driven incision. Geological Society of America Meeting Denver, CO

Hayden, A., Morgan, P., Cobin, P.F., Hess, A., Pryor, A.L., Young, E.M., Darling, A., Houghton, J., and **Aslan, A.** 2007. Late Holocene climate variability and implications for the onset of arroyo incision along the Little Dolores River, western Colorado. Geological Society of America Meeting Denver, CO

Kelley, S.E., Hudson, A.M., Kaproth, B.M., Landman, R.L., and **Aslan, A.** 2007. Long profile analysis of the Pleistocene Bostwick River with implications for the incision of the Black Canyon of the Gunnison. Geological Society of America Meeting Denver, CO

Darling, A., **Aslan, A.**, Betton, C.W., Cole, R.D., and Karlstrom, K. 2007. Late Quaternary incision rates and drainage evolution of the confluence of the Uncompahgre and Gunnison Rivers based on terraces date with Lava Creek B ash, western Colorado. Geological Society of America Meeting Denver, CO

Cobin, P.F., Hayden, A., Hess, A.V., Morgan, P., Pryor, A.L., Young, E., and **Aslan, A.** 2006. Holocene arroyo history of the Little Dolores River, Western Colorado. GSA Meeting, Philadelphia, PA

*Hudson, A.M., Kaproth, B., Kelley, S., Landman, R.L., and **Aslan, A**. 2006. Late Pleistocene gravel deposits of ancient Bostwick Creek in the Uncompahgre River Valley of southwestern Colorado. Abstracts with Programs, 2006 GSA Rocky Mountain Section meeting, Gunnison, CO.

*** Awarded Outstanding Student Paper at the 2006 Rocky Mountain Section of the Geological Society of America meeting, Gunnison, Colorado.**

Aslan, A., Quigley, J., Cole, T., Grubbs, D., Kellerby, D., Meunier, Y., Polson, J., Rodriguez, T., and **Stover, J**. 2005. Geological mapping of Quaternary Colorado and Gunnison River terrraces in the Grand Valley, western Colorado. Rocky Mt Section Meeting, Grand Junction, CO

Betton, C., **Aslan, A.**, and Cole, R., 2005. Late Cenozoic erosional history and major drainage changes of the Colorado Gunnison River systems, western Colorado. GSA Rocky Mt Section Meeting, Grand Junction, CO

Baker, G. and **Aslan, A.** 2005. Integrating geology and geophysics to determine the origin of Unaweep Canyon and Late Cenozoic fluvial incision in the Colorado Plateau-Rocky Mountain region. GSA Rocky Mt Section Meeting, Grand Junction, CO

Aslan, A., Nelson, M., Hayden, A., and Hodge, J. 2004. Geoarcheology and alluvial history of Sieber Canyon, Colorado Canyons National Conservation Area, Western Colorado. GSA Meeting, Denver, CO

Guevara, E.H., **Aslan, A.**, White, W.A., Raney, J.A., and Gibeaut, J.C. 2004. The Orinoco Delta, Venezuela: sedimentation near an active plate margin. American Association of Petroleum Geologists Annual Convention Abstracts Volume, v. 13, p. A56.

Guevara, E.H., **Aslan, A.**, Raney, J.A., White, W.A., and Gibeaut, J.C. 2004. The Orinoco Delta, Venezuela: sedimentary processes and facies of a major Holocene depositional system, *in* 32nd International Geological Congress, Abstracts, Part 2, Florence, Italy, August 20-28, p. 895-896.

Guevara, E.H., **Aslan, A.**, White, W.A., Raney, J.A., and Gibeaut, J.C. 2003. Depositional processes and facies distribution in the Orinoco Delta, Venezuela: constraints for reservoir models. American Association of Petroleum Geologists International Conference Official Program, p. A37.

Aslan, A., Wilson, R., Riddle, P., and Quist, E. 2003. Eolian influences on soils of the Grand Valley, western Colorado. GSA Meeting, Denver, CO

Garhart, A., Aslan, A., and Betton, C., 2003. Origin of late Cenozoic lacustrine deposits on the Uncompahgre Plateau of western Colorado, GSA Meeting, Denver, CO

Fandrich, J., Hollingsworth, J.S., and **Aslan, A.**, 2003. Westwater, Utah; a Quaternary ice-dam Lake on the Colorado River?, GSA Rocky Mt. Section Abstracts with Programs, v. 35(5), p. 39.

Technical Reports

Aslan, A., Karlstrom, K.E., and **Darling, A**. 2011. Origin of the Ancestral Colorado and Gunnison Rivers and Post-10 Ma River Incision Rates in Western Colorado. In Beard, L.S., Karlstrom, K.E., Young, R.A., and Billingsley, G.H., eds., 2011, CRevolution 2 -- Origin and evolution of the Colorado River system, workshop abstracts: U.S. Geological Survey Open-File Report 2011 -1210, 300 p., available at http://pubs.usgs.gov/of/2011/1210/.

Sandoval, M. M. Karlstrom, K.E., Darling, A., **Aslan, A.**, Granger, D., Wan, E., and Noe, D., and Dickinson, R. 2011. Quaternary Inicision History of the Black Canyon of the Gunnison, Colorado. In Beard, L.S., Karlstrom, K.E., Young, R.A., and Billingsley,

G.H., eds., 2011, CRevolution 2 --Origin and evolution of the Colorado River system, workshop abstracts: U.S. Geological Survey Open-File Report 2011 -1210, 300 p., available at http://pubs.usgs.gov/of/2011/1210/.

Darling, A., Karlstrom, K.E., **Aslan, A.**, and Granger, D. 2011. Differential incision rates in the upper Colorado River system: implications for knickpoint transience. In Beard, L.S., Karlstrom, K.E., Young, R.A., and Billingsley, G.H., eds., 2011, CRevolution 2 --Origin and evolution of the Colorado River system, workshop abstracts: U.S. Geological Survey Open-File Report 2011 -1210, 300 p., available at http://pubs.usgs.gov/of/2011/1210/.

Karlstrom, K., Coblentz, D., Ouimet, W., Kirby, E., Van Wijk, J., Schmandt, B., Crossey, L., Crow, R., Kelley, S., **Aslan, A**, Darling, A., Dueker, K., Aster, R., MacCarthy J., Lazear, G., and the CREST working group. 2011. Evidence from the Colorado River system for surface uplift of the Colorado Rockies and western Colorado Plateau in the last 10 Ma driven by mantle flow and buoyancy. In Beard, L.S., Karlstrom, K.E., Young, R.A., and Billingsley, G.H., eds., 2011, CRevolution 2 --Origin and evolution of the Colorado River system, workshop abstracts: U.S. Geological Survey Open-File Report 2011 -1210, 300 p., available at http://pubs.usgs.gov/of/2011/1210/.

Book Chapters

Aslan, A. 2006, Fluvial Sediments. In Elias, S. (ed.), Encyclopedia of Quaternary Science. Elsevier, p. 672-685.

Aslan, A. 2003, Floodplain Sediments. In Middleton, G.V. (ed.), Encyclopedia of Sediments and Sedimentary Rocks. Encyclopedia of Earth Sciences Series, Kluwer Academic Publishers, p. 285-287.

Aslan, A. 2003, Palaeosols. In Goudie, A.G. (ed.), Encyclopedia of Geomorphology. Routledge, London.

Aslan, A. 2003, Mud volcanoes. In Goudie, A.G. (ed.), Encyclopedia of Geomorphology. Routledge, London.

Other:
Grants

$94,870 (current, 2011-2014) 3 yr NSF Research Grant, Continental Dynamics, PI; collaborators are at University of New Mexico
$362,000 - NSF REU-Site (3 yr; 2005-2008) - REU PI
$12,000 - Geoarcheology of the Little Dolores River Valley, BLM grant. 2005-2006.
$15,000 - Geoarcheologic study of Sieber Canyon, Uncompahgre Plateau, BLM grant, 2003-2004

Field Trips Led for Professional Groups

2011 - Colorado Scientific Society, Glenwood Springs, CO
2010 - Geological Society of America, Denver, CO
2010 - Western Slope Field Conference, Grand Junction, CO
2009 - CREST field trip, Aspen, CO
2009 - American Institute of Professional Geologists, Unaweep Cyn, CO
2007 - Geological Society of America, Denver, CO
2005 - Geological Society of America, Rocky Mt Section, Grand Junction, CO

Invited Professional Presentations (not conference related)

2011-Rocky Mt Section Society of Economic Geologists, Denver, CO - invited speaker
2010-Colorado River Evolution Symposium, Flagstaff, AZ - invited speaker
2010-CU-Boulder, Geosicences Colloquium, Boulder, CO - invited speaker

2010-Grand Junction Geological Society - invited speaker
2009-CREST Workshop, Aspen, CO - presenter
2009-Colorado Mountain Club - invited presentation
2008-Utah State Univ. Geosicences Colloquium, Logan, Utah - invited speaker
2008-CREST Workshop, Santa Fe, NM - presenter
2008- Grand Junction Gem & Mineral Society
2007-CREST Workshop, Aspen, CO -presenter
2007-Grand Junction Geological Society - invited speaker
2007-Gateway Canyons Lecture Series - invited speaker
2006-CREST Workshop, Aspen, CO -presenter
2005-BLM Presentation, Grand Junction, CO

Sabbaticals

2007 - Summation of NSF-REU research on Landscape Evolution in western Colorado

Professional Memberships
Geological Society of America

Service 2003-Present:
University
2011
Student Showcase Committee
Tenure & Promotion Committee
Chair, Pre-Tenure & Promotion Committee
2010
Student Showcase Committee
Tenure & Promotion Committee
Pre-Tenure & Promotion Committee
2003-2009
Coordinator, MSC Student Scholars Symposium
Tenure & Promotion Committee (except 2007)

Department
2008-2011
PES Advisory Committee to Tenure-track faculty

Community

Regional

2011-2012 Chair, Rocky Mt Section, Geological Society of America
2005 Technical Program Co-Coordinator, Rocky Mt Section meeting, Geological Society of America

Advising 2003-Present:
Department level
2011- Advised 28 students, placed 1 student in summer job
2010 - Advised 20 students, wrote 4 recommendation letters, placed 2 students in jobs
2009 - Advised 18 students
2008 - Advised 21 students, wrote 2 recommendation letters, helped place 2 students in grad programs
2007-Advised 9 students
2006-Advised 11 students

2005-Advised 14 students
2004 - Advised 10 students
2003 - Advised 10 students

Honors and Awards 2003-Present:

Local
2006 Grand Valley Educator (1 of 20+ recipients)

2003 Mesa State College Outstanding Achievement in Scholarship Award

Professional Experience:
Mesa State College-Colorado Mesa University, From 1999-2012 Field investigations of Pleistocene Colorado River deposits in CO, Mississippi River deposits in LA and AR and geoarcheologic studies of Holocene sediments in western CO. Currently involved in study of the long-term evolution of the Colorado and Green Rivers.

Bureau of Economic Geology, U. of Texas at Austin, Project sedimentologist 1998 to 1999. Participated in a geo-environmental study of the Orinoco Delta in Venezuela. Used remote sensing (radar, Landsat TM) and field data (GPS surveys, shallow cores) to study depositional systems and active geologic processes of the Delta.

Howard University-Geological Survey of Pakistan, Project sedimentologist 1991 and 1997. Conducted field and petrographic studies of Eocene alluvial paleosols, coastal plain, and shallow marine deposits in the Kohat Basin, Pakistan as part of a study on whale evolution. Collaborator: Dr. Hans Thewissen (NEOUCOM).

University of Nebraska, Sedimentologic consultant summers of 1995 and 1996. Conducted field, mineralogic, and petrographic studies of Quaternary fluvial deposits and alluvial paleosols of the Colorado River, Texas Coastal Plain. Collaborator: Dr. M.D. Blum (L.S.U.).

University of Colorado, Research associate 1995-1996; Research assistant 1989-1994. M.S.: Used field, petrographic, and geochemical data to decipher depositional and hydrologic histories of alluvial paleosols in the Eocene Willwood Fm., WY. Ph.D.: used sediment cores, geologic mapping, and petrographic and geochemical data to investigate Holocene floodplain sedimentation and soil formation in the Lower Mississippi Valley.

Louisiana State University, Research associate 1992-1995. Collaborator on field mapping projects with Dr. W.J. Autin (Louisiana Geological Survey/L.S.U.)

Shell Oil Co. Houston, TX, Geologist in Gulf Coast Tertiary Exploration summer of 1990. Conducted a regional study of deltaic sandstones of the Eocene Wilcox Fm. in south Texas using electric well logs. Designed a computer database that was used to construct stratigraphic cross sections and sand isopach maps.

Smithsonian Institution, Research assistant in the Dept. of Paleobiology 1986-1987. Participated in field studies of bone accumulation in rivers in Colorado and Wyoming and established a computer database. Supervisor: Dr. A.K. Behrensmeyer.

Please record the number "items/events" you have listed above in the following categories.
If you specify items/events under "other," please provide an explanation/definition.

0	**Books**	0	**Book Reviews**	0	**Creative Publications**
8	**Journal Articles**	0	**Performances**	0	**Patents**
27	**Conference Presentations**	0	**Exhibitions**	4	**Grants-funded and non-funded**
1	**Sabbaticals**	0	**Fullbright**	4	**Book Chapter**
21	**Other (related to discipline)**				

Name:

Rex D. Cole

Start Year: 1995

Program:
Physical Sciences

Department:
Physical and Environmental Sciences

COLORADO MESA UNIVERSITY

Full-time Faculty Vita

Faculty Rank

(•) Professor ( ) Assistant Professor

( ) Associate Professor ( ) Instructor

Highest Degree

PhD Institution University of Utah Discipline Geology Year 1975

Education: (List all degrees beginning with most recent-include post docs and external certificates)

Registered Professional Geologist, Wyoming, 1992-Present (No. PG-463)

Ph.D. (Geology) University of Utah, 1975

B.S. (Geology), Colorado State University, 1970

A.S. (Geology), Mesa College, 1968

Teaching 2003-Present:

Courses Taught
GEOL 105, Geology of Colorado
GEOL 112, Principles of Historical Geology
GEOL 112L, Principles of Historical Geology Laboratory
GEOL 202, Introduction to Field Studies
GEOL 359, Survey of Energy-Related Natural Resources
GEOL 396, Topics -- Subsurface Methods
GEOL 444, Sedimentology and Stratigraphy
GEOL 444L, Sedimentology and Stratigraphy Laboratory
GEOL 480, Summer Field Camp
GEOL 497, Structured Research

Evidence of Continuous Improvement
Rocky Mountain Sectional Meeting of the American Association of Petroleum Geologists, 2011
Rocky Mountain Sectional Meeting of the American Association of Petroleum Geologists, 2003
Origin and Evolution of the Colorado River System II, U.S. Geological Survey, 2010
Piceance Basin Tight-Gas Research Symposium of Research Program to Secure Energy for America, 2010
National Meeting of the American Institute of Professional Geologists, 2009
National Meeting of the American Association of Petroleum Geologists, 2009
Rocky Mountain Sectional Meeting of the American Association of Petroleum Geologists, 2008
National Meeting of the Geological Society of America, 2007
National Meeting of the American Association of Petroleum Geologists, 2007
Rocky Mountain Sectional Meeting of the Geological Society of America, 2006
National Meeting of the American Association of Petroleum Geologists, 2006
Rocky Mountain Sectional Meeting of the American Association of Petroleum Geologists, 2005
Rocky Mountain Sectional Meeting of the Geological Society of America, 2005
Rocky Mountain Sectional Meeting of the Geological Society of America, 2004
Rocky Mountain Sectional Meeting of the American Association of Petroleum Geologists, 2004
Piceance Basin Symposium, Rocky Mountain Association of Geologists, 2003

Innovative Materials/Activities

Converted all lecture notes to PowerPoint presentations.

Collected several thousand digital geologic photographs throughout western Colorado and eastern Utah to use in lectures.

Supervision of Student Research/Project(s)

Graduate Students

2011- Aya Attar (M.S. in Geology) at CU-Boulder (probable outside committee member).
2011- Tuba Evsan (M.S. in Geology) at CU-Boulder (probable outside committee member).
2011- John McFadden, Jr. (M.S. in Geology) at CU-Boulder (probable outside committee member).
2011- Ellen Wilcox (M.S. in Geology) at CU-Boulder (probable outside committee member).
2011- Daniel Allen (M.S. in Geology) at CU-Boulder (probable outside committee member).
2009- Gabriela I. Keeton (M.S. in Geology) at CU-Boulder (outside committee member).
2009- Jeremy Ring (M.S. in Geology) at CU-Boulder (outside committee member).
2009-10 Alicia Hewlett (M.S. in Geology) at CU-Boulder (outside committee member).
2009-10 Rachel Shaak (M.S. in Geology) at CU-Boulder (outside committee member).
2009-11 Kim Hlava (M.S. in Geology) at CU-Boulder (outside committee member).
2009-11 Ericka Harper (M.S. in Geology) at CU-Boulder (outside committee member).
2009-11 Ali Sloan (M.S. in Geology) at CU-Boulder (outside committee member).
2007- Adel Aboktef (Ph.D. in Geology) at CU-Boulder (outside committee member for dissertation review).
2007-09 Brandon Binford (M.S. in Geology) at CU-Boulder (outside committee member).
2005-07 Nick Sommer (M.S. in Geology) at CU-Boulder (outside committee member).
2004-06 Quinten German (M.S. in Geology) at CU-Boulder (outside committee member).
2002-04 Amanda Ellison (M.S. in Geology) at CU-Boulder (outside committee member).
1999-03 Matt Stikes (M.S. in Geology) at Northern Arizona University (outside committee member).

MSC/CMU Students

2011-12, Scott Schinderlar - Structured Research on Williams Fork Formation with CU-Boulder graduate students
2011-12, Kasmira Workman - Structured Research on Williams Fork Formation with CU-Boulder graduate students
2010, Beau Taylor -- Structured Research on Williams Fork Formation with CU-Boulder graduate students
2010, Marko Gorenc -- Structured Research on Williams Fork Formation with CU-Boulder graduate students
2008, Ericka Harper -- Structured Research on Williams Fork Formation with CU-Boulder graduate students

Scholarship and Creative Work, 2003-Present:

Scholarship Related to Discipline

Guide Books (used for geological field trips, published by professional societies)

Rex Cole, Matt Pranter, Steve Cumella, and Mark Kirschbaum, 2009, SEPM Field Trip 12 - Iles-Williams Fork field trip, southern Piceance Basin, Colorado: Society of Economic Paleontologists and Mineralogists; held in conjunction with the 2009 national meeting of the American Association of Petroleum Geologists, Denver.

William Hood, Tom Oesleby, Andres Aslan, **Rex Cole**, Charles Betton, and Mary Benage, 2008, Geological history of Unaweep Canyon: a re-appraisal: Grand Junction Geological Society, 26 p.

R. Cole, M. Kirschbaum, and R. Young, 2005, Stratigraphy, sedimentology, and energy resources of Cretaceous Rocks in the Book Cliffs area, Western Colorado and eastern Utah, in Guidebook for the Rocky Mountain Section of the Geological Society of America annual meeting: Grand Junction Geological Society, 76 p.

R. Cole, and S. Cumella, 2004, Stratigraphic architecture and reservoir characteristics of the Mesaverde Group, southern Piceance Basin, Colorado: Denver, Rocky Mountain Section of American Association of Petroleum Geologists guidebook, 60 p.

K.W. Shanley, J.M. Boyles, J.R. Suter, D. Nummedal and **R. Cole**, 2003, Sedimentology and sequence stratigraphic response to changes in accommodation: predicting reservoir architecture, Book Cliffs, Utah: guidebook prepared for the 2003 annual meeting of the American Association of Petroleum Geologists.

R. Cole, and S. Cumella, 2003, Stratigraphic architecture and reservoir characteristics of the Mesaverde Group, southern

Piceance Basin, Colorado: Denver, Rocky Mountain Association of Geologists guidebook, p. 386-442.

Journal Articles

Matt Pranter, Alicia Hewlett, **Rex Cole**, Huabing Wang, and James Gilman, 2011, Fluvial architecture and connectivity of the Williams Fork Formation: use of outcrop analogues for stratigraphic characterization and reservoir modeling, in Good, T., Howell, J., and Martinius, A.W., eds., Sediment body geometry and heterogeneity: analogue studies for modeling the subsurface: Geological Society of London Special Publication, in press.

Matthew J. Pranter, **Rex D. Cole**, Henrikus Panjaitan, and Nicholas K. Sommer, 2009, Sandstone-body dimensions in a lower coastal-plain depositional setting: lower Williams Fork Formation, Coal Canyon, Piceance Basin, Colorado: Bulletin of American Association of Petroleum Geologists, v. 93, no. 10, p. 1379-1401.

Matthew J. Pranter, Amanda I. Ellison, **Rex D. Cole**, and Penny E. Patterson, 2007, Analysis and modeling of intermediate-scale reservoir heterogeneity based on a fluvial point-bar outcrop analog, Williams Fork Formation, Piceance Basin, Colorado: Bulletin of American Association of Petroleum Geologists, v. 91, no. 7, p. 1025-1051.

R. Cole and S. Cumella, 2005, Sand-body architecture in the lower Williams Fork Formation (Upper Cretaceous), Coal Canyon, Colorado, with comparison to the Piceance Basin subsurface: The Mountain Geologist, v. 42, no. 3, p. 85-107.

Conference Presentations (Abstracts)

E. Harper, K. Hlava, **R. Cole**, and M. Pranter, 2011, Stratigraphic variability of coastal-plain and marginal-marine deposits of the middle Mesaverde Group, Douglas Creek Arch, Colorado: American Association of Petroleum Geologists National Meeting, Houston, TX.

R. Cole and M. Pranter, 2011, Coastal- and alluvial-plain architectural elements of the Upper Cretaceous Williams Fork Formation, southeast Piceance Basin, Colorado: Outcrop analogs for subsurface reservoir characterization: Rocky Mountain Section of American Association of Petroleum Geologists, Cheyenne, WY.

R. Cole, 2010, Stratigraphic and sedimentologic framework of the Iles and Williams Fork Formations, as expressed in the outcrop belt of the SE Piceance Basin, with implications for Mamm Creek field: Piceance Basin Tight-Gas Research Symposium, Research Program to Secure Energy for America (RPSEA)

R. Cole, 2010, Significance of the Grand Mesa basalt field in western Colorado for defining the early history of the upper Colorado River: Origin and evolution of the Colorado River System II, Flagstaff, AZ, U.S. Geological Survey Open File Report (2011 publication date)

R. Cole, M. Heizler, K. Karlstrom, and A. Stork, 2010, Eruptive history of the Grand Mesa Basalt Field, western Colorado: Geological Society of America Annual (National) Meeting Program with Abstracts.

R. Cole and M. Pranter, 2009, Detailed architectural analysis of two point-bar complexes in the Cameo interval of the lower Williams Fork Formation at 'Hoodoo Hill', southwestern Piceance Basin, Colorado: American Association of Petroleum Geologists Annual (National) Meeting, in proceedings volume.

E. Harper, **R.D. Cole**, and M.J. Pranter, 2009, Dimensions of fluvial geobodies in the middle Williams Fork Formation (Late Cretaceous), Main Canyon, Colorado: American Association of Petroleum Geologists Annual (National) Meeting, in proceedings volume.

M. Pranter, B. Binford, and **R. Cole**, 2009, Analysis and modeling of fluvial sandstone-body architecture and heterogeneity in the Cameo interval of the lower Williams Fork Formation in Coal Canyon, southwestern Piceance Basin, Colorado: American Association of Petroleum Geologists Annual (National) Meeting, in proceedings volume.

R. Cole and K. Weston, 2009, Geology of Grand Mesa Basalt Field, western Colorado: proceedings volume for the national meeting of the American Institute of Professional Geologists, Grand Junction.

R.D. Cole and M.J. Pranter, 2008, Stratigraphic variability of sandstone-body dimensions in the Williams Fork Formation: outcrop data from the southwest Piceance Basin, Colorado: Rocky Mountain Section of the American Association of Petroleum Geologists Annual Meeting, in proceedings volume.

N.K. Sommer, M.J. Pranter, and **R.D. Cole**, 2008, Sandstone-body connectivity in a meandering-fluvial system: an example from the Williams Fork Formation, Piceance Basin, Colorado: Rocky Mountain Section of the American Association of Petroleum Geologists Annual Meeting, in proceedings volume.

M.J. Pranter, H.P., Q.A. German, Z.A. Reza, **R.D. Cole**, N.F. Hurley, and D.S. Anderson, 2007, Fluvial Sandstone-Body Dimensions and Reservoir Connectivity within a Meandering to Braided System: An Example From the Williams Fork Formation, Piceance Basin, Colorado: American Association of Petroleum Geologists Annual (National) Meeting, in

proceedings volume.

R. Cole, 2007, Fluvial sand-body dimensions and architecture, Neslen and Lower Farrer Formations (Campanian), lower Sego Canyon, Utah: American Association of Petroleum Geologists Annual (National) Meeting, in proceedings volume.

N.K. Sommer, M. J. Pranter, and **R. D. Cole**, 2007, Reservoir-scale analysis of sandstone-body dimensions in a braided fluvial system, upper Williams Fork Formation, Main Canyon, Piceance Basin, Colorado: American Association of Petroleum Geologists Annual (National) Meeting, in proceedings volume.

R.D. Cole, 2007, Grand Mesa: an important control point for establishing the late Cenozoic history of western Colorado: Geological Society of America Annual (Natioual) Meeting Program with Abstracts.

R.D. Cole, and K. Weston, 2007, The Grand Mesa basalt field, western Colorado: Geological Society of America Annual (National) Meeting Program with Abstracts.

S.D. Schoepfer, S. Martin, M. Benage, D. Bock, J.R. Noble, O. Compton, and **R. Cole**, 2007, Quaternary abandonment and sedimentary fill history of Cactus Park and Unaweep Canyon, Uncompahgre Plateau, Colorado: Geological Society of America Annual (National) Meeting Program with Abstracts.

A. Darling, K. Rider, J. Gloyd, and **R.D. Cole**, 2007, Sedimentologic characteristics of late Cenozoic gravel-armored surfaces on the southwestern flank of Grand Mesa, western Colorado: Geological Society of America Annual (National) Meeting Program with Abstracts.

A. Darling, A. Aslan, C.W. Betton, **R.D. Cole**, and K. Karlstrom, 2007, Late Quaternary incision rates and drainage evolution of the confluence of the Uncompahgre and Gunnison Rivers based on terraces dated with Lava Creek B ash, western Colorado: Geological Society of America Annual (National) Meeting Program with Abstracts.

N. Sommer, Q. German, M. Pranter, and **R. Cole**, 2006, Analysis of fluvial sand-body characteristics and dimensions in a high net-to-gross system, upper Williams Fork Formation, Main and Plateau Canyons, Piceance Basin, Colorado: Rocky Mountain Sectional Meeting of the American Association of Petroleum Geologists, in proceedings volume.

Q. German, M. Pranter, and **R. Cole**, 2006, Analysis of fluvial sand-body characteristics and connectivity in a high net-to-gross system, Upper Williams Fork Formation, Plateau Creek Canyon, Piceance Basin, Colorado: American Association of Petroleum Geologists Annual (National) Meeting, in proceedings volume.

K. Rider, A. Darling, J. Gloyd, and **R. Cole**, 2006, Relative ages and origins of late Cenozoic pediments on the south flank of Grand Mesa, Colorado: Rocky Mountain Section of Geological Society of America Program with Abstracts.

R. Cole, 2006, A geomorphic approach for predicting reservoir volumes in high-sinuosity fluvial sand bodies in the lower Williams Fork Formation, southwest Piceance Basin, Colorado: Rocky Mountain Section of Geological Society of America Program with Abstracts.

R. Cole, 2005, Characterization of fluvial sand bodies in the lower Williams Fork Formation (Campanian), Coal Canyon Area, Colorado: Rocky Mountain Section of Geological Society of America Program with Abstracts, p. 44.

C. Betton, A. Aslan, and **R. Cole**, 2005, Late Cenozoic erosional history and major drainage changes of the Colorado-Gunnison River systems, western Colorado: Rocky Mountain Section of Geological Society of America Program with Abstracts, p. 35.

R. Cole, and S. Cumella, 2004, Fluvial sand-body dimensions in the lower Williams Fork Formation (Upper Cretaceous), southwestern Piceance Basin, Colorado: Rocky Mountain Sectional Meeting of the American Association of Petroleum Geologists, in proceedings volume.

A. Ellison, M. Pranter, **R. Cole**, and P. Patterson, 2004, Anatomy of a point bar: outcrop modeling using Lidar data for the Upper Cretaceous Williams Fork Formation, Piceance Basin, Colorado: Rocky Mountain Sectional Meeting of the American Association of Petroleum Geologists, in proceedings volume.

A. Ellison, M. Pranter, **R. Cole**, and P. Patterson, 2004, Quantification of stratigraphic heterogeneity within a fluvial point-bar sequence, Williams Fork Formation, Piceance Basin, Colorado: application to reservoir modeling: Rocky Mount Sectional Meeting of the American Association of Petroleum Geologists, in proceedings volume.

R. Cole, and S. Cumella, 2003, Facies-architecture of fluvial sand bodies in the Williams Fork Formation (Upper Cretaceous), southwestern Piceance Basin, Colorado: Rocky Mountain Association of Geologists Piceance Basin Field Symposium, October 5, 2003.

A. Ellison, M. Pranter, **R. Cole**, P. Patterson, and S. Cumella, 2003, Analysis and modeling of stratigraphic architecture of the Upper Cretaceous Williams Fork Formation, Piceance Basin, Colorado through outcrop studies and Lidar imaging:

Rocky Mountain Association of Geologists Piceance Basin Field Symposium, October 5, 2003.

A. Ellison, M. Pranter, **R. Cole**, and P. Patterson, 2003, Stratigraphic architecture of the Upper Cretaceous Williams Fork Formation, Piceance Basin, western Colorado through outcrop studies and high-resolution Lidar imaging: Geological Society of America Program with Abstracts (annual meeting).

Technical Reports

Over the reporting period, I conducted 17 major technical projects for a variety of industrial clients. This work was proprietary, so the titles can not be disclosed. The projects involved the petroleum and mineral resources of the Colorado Plateau and northern Alaska. These projects were completed during the summer and other non-academic times.

Book Chapters

R. D. Cole, 2011, Significance of the Grand Mesa basalt field in western Colorado for defining the early history of the upper Colorado River, in Beard, L. Sue, Karlstrom, Karl E., Young, Richard E., and Billingsley, George H., CREvolution 2 -- Origin and Evolution of the Colorado River System, Workshop Abstracts: U.S. Geological Survey Open-file Report 2011-1210, p. 55-61.

Andres Aslan, Karl Karlstrom, Laura Crossey, Shari Kelley, **Rex Cole**, Greg Lazear, and Andy Darling, 2010, Late Cenozoic evolution of the Colorado Rockies: evidence for Neogene uplift and drainage integration, in Morgan, L.A., and Quane, S. L., eds., Through the generations: Geologic and anthropogenic field excursions in the Rocky Mountains from modem to ancient: Geological Society of America Field Guide 18, p. 21-54.

Rex Cole, 2008, Characterization of fluvial sand bodies in the Neslen and lower Farrer Formations (Upper Cretaceous), lower Sego Canyon, Utah, in Longman, W. and Morgan, C., eds., Hydrocarbon systems and production in the Uinta Basin, Utah: Rocky Mountain Association of Geologists and Utah Geological Association Joint Publication no. 37, p. 81-100.

Howard, White, **Rex Cole**, Steve Stancel, Carrie Lee, and Logan MacMillian, 2008, "Window" outcrop analogs for Greater Natural Buttes Field, Uinta Basin, Utah, in Longman, W. and Morgan, C., eds., Hydrocarbon systems and production in the Uinta Basin, Utah: Rocky Mountain Association of Geologists and Utah Geological Association Joint Publication no. 37, p. 209-235.

Donna Anderson, **Rex Cole**, David Keighley, and Robert Ressetar (compiler), 2008, Outcrop analogs to source and reservoir rocks of the Uinta Basin, in Longman, W. and Morgan, C., eds., Hydrocarbon systems and production in the Uinta Basin, Utah: Rocky Mountain Association of Geologists and Utah Geological Society Joint Publication no. 37, p. 403-468.

Andres Aslan, Karl Karlstrom, William Hood, **Rex Cole**, Tom Oesleby, Charles Betton, Magdalena Sandoval, Andrew Darling, Shari Kelley, Adam Hudson, Brian Kaproth, Shane Schoepfer, Mary Banage, and Rachael Landman, 2008, River incision histories of the Black Canyon of the Gunnison and Unaweep Canyon: interplay between late Cenozoic tectonism, climate change, and drainage integration in the western Rocky Mountains, in Raynolds, R.G., ed., Roaming the Rocky Mountains and environs: Geological Society of America Field Guide 10, p. 175-202.

Other

Rex Cole, 2010, The making of the Mesa: Grand Valley Magazine, December, 2010 issue, 5 p. Note: this magazine does not have pagination.

Scholarship Related to Pedagogy in Discipline

Books -- None
Journal Articles -- None
Conference Presentation -- None
Book reviews -- None
Technical Reports -- None
Book Chapters -- None
Other -- None

Creative Work Related to Discipline

Performances -- None

Exhibits -- None
Publications -- None

Other:

Grants

2005 Co-investigator on a successful National Science Foundation REU grant to Mesa State College.
2009 Received $25,000 from the University of Colorado, Boulder, to conduct research on the Williams Fork Formation in the Piceance Basin, Colorado. Funding also includes work with geology graduate students at CU-B, as listed above.
2009 Received a grant ($32,387) from Colorado School of Mines for research on the Williams Fork Formation in the Piceance Creek Basin, CO. Funding source was from RPSEA/U.S. Dept. of Energy (project title: "Reservoir Connectivity and Stimulating Gas Flow in Tight Sands; Task 4 - Development of Static Reservoir Models"). Project completed in 2011.
2006-2007 Colorado Energy Research Institute (CERI), $75,000.

Patents -- None through CMU

Unpublished research

A draft of a book on the geology of Grand Mesa will be completed in late 2012 (approximately 250 page manuscript with figures, tables and photographs).

Sabbatical

Fall Semester, 2004

Fullbright -- None

Professional Memberships

Geologic Society of America -- Past chair of Rocky Mountain Section (2005)
Grand Junction Geological Society (honary life member)

Service 2003-Present:

University

Curriculum Committee
Tenure and Promotion Committee
Sabbatical Committee
Professional Development Committee
Faculty Search Committees (PES)

Department

Served as Coordinator for the Geology Program for the entire reporting period (2003-2011).
Member of planning committee for renovation of Wubben Hall and New Science Lab Building

Community

Judge for Western Colorado Science Fair, 2003-2010
Speaker at Grand Junction Gem and Mineral Club
Speaker at Grand Junction Chapter of Society of Petroleum Engineers
Conducted field trips on Grand Mesa for U.S. Forest Service, the Grand Junction Geologic Society, and the San Juan Mountain Study Group
Speaker at the Palisade Institute in Gateway, CO
Speaker at Garfield County Energy Advisory Group meetings (Rifle, CO)
Speaker for the San Miguel County Commissioners (Telluride and Norwood, CO)

Regional

Speaker at meeting of the Colorado Oil and Gas Conservation Commission (Denver)

Local

Grand Junction Geological Society -- CMU meeting coordinator
Grand Junction Geological Society -- Field trip coordinator for 2012 Rocky Mountain Sectional Meeting of the American Association of Petroleum Geologists (Sept. 2012 meeting)

Advising 2003-Present:

University level

Participated in various meetings on energy resources.

Department level

More than 100 geology majors over the last 10 years.

Honors and Awards 2003-Present:

Regional

2008 Received (with Matt Pranter) the A.I. Levorsen Award for best oral presentation at the Rocky Mountain Section Meeting of the American Association of Petroleum Geologists (Denver meeting)
2005 Receive Best Paper of the Year (2005) Award from the Rocky Mountain Association of Geologists (Denver) for paper with Steve Cumella in the *Mountain Geologist*
2004 Electeded as General Chair for the 57th Meeting (2005) of the Rocky Mountain Section of the Geological Society of America.
2003 Invited speaker for the monthly meeting of the Rocky Mountain Association of Geologists (Denver)

Local

2006 Received Outstanding Achievement in Scholarship Award from Mesa State College
2004 Nominated for a distinguished faculty award (overall) at Mesa State College
2004 Awarded a Lifetime Membership in the Grand Junction Geological Society in recognition for prolonged service

Professional Experience:

2011- Professor of Geology; Department of Physical and Environmental Sciences, Colorado Mesa University, Grand Junction, CO; also Geology Program Coordinator.

1999-11 Professor of Geology; Department of Physical and Environmental Sciences, Mesa State College, Grand Junction, CO; also Geology Program Coordinator.

1995-99 Associate Professor of Geology; Department of Physical and Environmental Sciences, Mesa State College, Grand Junction, CO.

1983-95 Sr. Advising Geologist; Unocal Corp., Production and Development Technology Group, Brea, CA.

1982- Consulting Geologist; R.D. Cole and Associates, Grand Junction, CO.

1980-82 Manager of Geotechnical Operations; Multi Mineral Corp., Grand Junction, CO.

1978-80 Staff Geoscientist IV; Bendix Field Engineering Corporation, Grand Junction, CO.

1975-77 Assistant Professor of Geology; Department of Geology, Southern Illinois University, Carbondale, IL.

1973-75 Exploration Geologist; American Smelting and Refining Company, Salt Lake City, UT (part time).

1970-73 Teaching Fellow and Research Assistant; Department of Geology and Geophysics, University of Utah, Salt Lake City, UT (academic months).

1971 Exploration Geologist; Inspiration Development Company, Spokane, WA (summer).

1970 Exploration Geologist; Duval Corporation, Salt Lake City, UT (summer).

1968 Assistant Geologist; Petro-Nuclear Ltd., Naturita, CO (summer).

Please record the number "items/events" you have listed above in the following categories.
If you specify items/events under "other," please provide an explanation/definition.

6	**Books**	0	**Book Reviews**	0	**Creative Publications**
4	**Journal Articles**	0	**Performances**	0	**Patents**
31	**Conference Presentations**	0	**Exhibitions**	4	**Grants-funded and non-funded**
1	**Sabbaticals**	0	**Fullbright**	6	**Book Chapter**
1	**Other (related to discipline)**	Local magazine article			

Name:

Verner C Johnson

Start Year: 1976

Program:
Physical Sciences

Department:
Physical and Environmental Sciences

COLORADO MESA UNIVERSITY

Full-time Faculty Vita

Faculty Rank

(•) Professor ( ) Assistant Professor

( ) Associate Professor ( ) Instructor

Highest Degree

PhD	University of Tennessee at Knoxville	Geology	1975

Education: (List all degrees beginning with most recent-include post docs and external certificates)

Ph. D., Geology, University of Tennessee at Knoxville, 1975

M.S., Geology, Southern Illinois University at Carbondale, 1970

B.A., Geology, Southern Illinois University at Carbondale, 1967

Teaching 2003-Present:

Courses Taught
GEOL 100, Survey of Earth Science
GEOL 105, Geology of Colorado
GEOL 111/111L, Principle of Physical Geology and Laboratory
GEOL 204, Computer Applications in Geology
GEOL 110, Environmental Geology
GEOL 305, Cartography for GIS
GEOL 332/332L, BIOL 332/332L, ENVS 332/332L Introduction to Geographic Information Systems and Laboratory
GEOL375/375L, Global Positioning Systems for GIS and Lab
GEOL 404/404L, Geophysics and Lab
GEOL 432/432L, Advanced Geographic Information Systems and Lab
GEOL 490, Summer Field Camp
GEOL 493, Co-operative Education
GEOL 495, Independence Study
GEOL 496, Topics-GIS Applications in Geology and Lab
GEOL 497, Structured Research

Evidence of Continuous Improvement
Attended Geogathering 2007 in Estes Park, May 7 and 8, 2007
Attend Grand Junction Geological Society every month

Innovative Materials/Activities
Revised lab manuals for Introduction to GIS and Advanced GIS to be more compatible to the newer version of ArcGIS
Revised and updated PowerPoints for all classes

Supervision of Student Research/Project(s)
2011: Miller, Roger; A geologist's guide to the Mesozoic Rocks of Canyonlands and Arches National Parks, Utah (sponsor, GEOL495, Independent Study Project - summer)
Graham, Jennifer; GIS Makes it possible for oil and gas exploration (sponsor: GEOL 497 Structured Research Project, presented in student showcase)
Smolek, Audra; Hydrology of the Grand Mesa (sponsor: GEOL 497 Structured Research Project, presented in student showcase)

Scholarship and Creative Work, 2003-Present:
Scholarship Related to Discipline

Conference Presentation
Keynote presentation for the Hearing Loss Association Oct. 30, 2010.
Gave presentation about the Mesa State College (Now Colorado Mesa University) about GIS program in GIS Colorado, January 26, 2007
Gave a presentation on "GIS Applications in Hydrology" to Western Slope GIS User Group Meeting, July 26, 2003.
Attended Grand Junction Geological Meeting every month.

Other:
Grants
2005 - Con't: BLM GIS Internship grants. The original grant contract from the BLM, began in January 13, 2005. We have obtained approximately $95,000 since 2005 for student assistants working for BLM. Each semester, two students in the GIS program work for BLM performing tasks that include GIS, GPS, and Remote Sensing. Funds is used to pay salary and benefits for students working on BLM projects.

2006-2008: Took part of the National Science Foundation-Research Experiences for the Undergraduate on "A Field -Based Study of Landscape Evolution of Western Colorado" from 2006-2008

2003 - 2005: Forest Service Internship grants. Similar to the BLM Internship grants. We have obtained approximately $45,000 from the Forest Service to hire one or two students to do GIS projects in the forest service offices in Delta and Grand Junction, Colorado.

Patents

Unpublished research
Gravity and magnetic survey of the northeastern part of the Uncompahgre Plateau, Colorado.

Professional Memberships
American Association of Professional Geologists
American Geophysical Union
Society of Exploration Geophysicists
Grand Junction Geological Society
President (1996)
Vice _ President (1997)
Past_President (since 1998)
Sigma Gamma Epsilon
Faculty Advisor of the CMU Zeta Nu Chapter (1990 - 2011)
Geological Society of America

Service 2003-Present:
University
Conducted GIS GIS workshops for faculty and staff members of Mesa State College (Now Colorado Mesa University) every semester from 2003 -2006

Department
Coordinated Exit Exam for Graduating Geology Students with Rex Cole, Rick Livaccari, Andes Aslan, and Gigi Richard

Supervise student assistants in geology laboratory.

Work with Dave Wolny, a seismologist, in Earthquake Information Center in CMU.

1990 - 2011: Faculty advisor of the Zeta Nu Chapter of the Sigma Gamma Epsilon, the national honor society for the earth scientists.

Community

National
Conducted workshop on "GIS and Public Development of Oil and Gas Resources" July 31-August 2, 2007.
Conducted workshop on "Implementing Geotechnologies for Mining and Petroleum Industries" Jan 16-18, 2007.
Conducted workshop on "GIS Institute for Educators" August 4-6, 2003.
Conducted workshop on "GIS for K-12 teachers" April 5, 2003.

Advising 2003-Present:

Department level

Teacher Licensure Advisor: I advised three earth science teacher licensure majors. Because of my involvement with NCAT, I was best fit to advice students who wish to pursue teaching earth science in secondary schools. I checked their records to be sure they had taken required geology and education courses. I encouraged them to go for "student assistantship" and be lab assistant in any or combination of GEOL111, GEOL113, and GEOL112 labs during the last semester before internship. Purpose was to give them teaching experience so they can be better prepared for EDUC 499, Teacher Internship.

GIS&T Advisor: I advised GIS&T minor and/or Certificate students as to what courses they need to take before completing GIS&T Minor and/or Certificate program. I proposed scheduling of GIS courses they need to take each semester pending on how much time they have left before graduation. I also advised non-students (not enrolled in any other program) as to what they need to take which they can complete all the required courses in one year. I advised more than 20 students going into GIS&T minor or certificate.

Geology Advisor: I advised 34 geology and environmental geology majors.

BLM Internship Advisor: A federal government organization, BLM, has internship contracts with Mesa State College. My responsibility includes finding qualified students and signing payroll forms. I also watch budget to be sure that we are within the budget. I do advice prospect interns to prepare resumes and interview for the BLM positions.

Honors and Awards 2003-Present:

Local

1) Received Outstanding Teacher Award from Colorado Mesa University (formerly Mesa State College) for the 2002-2003 academic year.

Professional Experience:

My background is teaching in any of my specialized areas including GIS/GPS, geophysics, hydrogeology, computer applications in geology, environmental geology, and engineering geology. I have more than thirty years of geophysical, geological, and GIS/GPS related experiences includes: proposing and organizing plans for research and teaching, acquiring and interpreting data, problem solving, and preparing verbal and written communication.

EMPLOYMENT HISTORY:

Sept., 1976 _ Colorado Mesa University (formerly MESA STATE COLLEGE)
Present Grand Junction, CO
Professor (1995 _ Cont) __ tenured since 1995
GIS/GPS Coordinator (Aug., 1999 - continued)
Geology Program Coordinator (Jan., 1997 _ Jan., 1999)
Geology Teacher Licensure Coordinator (Aug., 2000 - continued)
Internship and Supervisor GIS Coordinator (Aug. 2000 - continued)
Associate Professor (1989 _ 1995)
Instructor (1984 _ 1989)
Adjunct Faculty (1976 - 1984)

Please record the number "items/events" you have listed above in the following categories.
If you specify items/events under "other," please provide an explanation/definition.

Books	**Book Reviews**	**Creative Publications**
Journal Articles	**Performances**	**Patents**
Conference Presentations	**Exhibitions**	**Grants-funded and non-funded**
Sabbaticals	**Fullbright**	**Book Chapter**
Other (related to discipline)		

Name:

Richard F Livaccari

Start Year: 1997

Program:
Physical Sciences

Department:
Physical and Environmental Sciences

COLORADO MESA UNIVERSITY

Full-time Faculty Vita

Faculty Rank

(•) Professor ( ) Assistant Professor

( ) Associate Professor ( ) Instructor

Highest Degree

PhD Institution: University of New Mexico Discipline: Geology Year: 1994

Education: (List all degrees beginning with most recent-include post docs and external certificates)

Post-Doc 1995-1997, University of New Mexico, Albuquerque, NM, Geology
Ph.D. 1994, University of New Mexico, Albuquerque, NM, Geology
M.Sc. 1980, State University of New York at Albany, Albany, NY, Geology
B.Sc. 1977, University of New Mexico, Albuquerque, NM, Geology/Math

Teaching 2003-Present:

Courses Taught

GEOL 113/113L Field-Based Introduction to Physical Geology and Laboratory
GEOL 301/301L Structural Geology and Laboratory
GEOL 321/321L Introduction to Remote Sensing and Laboratory
GEOL 331/331L Crystallography and Mineralogy and Laboratory
GEOL 333 Geology of Canyon Country
GEOL 340/340L Igneous and Metamorphic Petrology and Laboratory
GEOL 480 Summer Field Camp
GEOL 497 Structured Research

Evidence of Continuous Improvement

2011 Geological Society of America Rocky Mountain and Cordillera combined Sections annual meeting in Logan, UT
2007 Geological Society of America, Annual Meeting in Denver, CO
2006 Geological Society of America, Rocky Mountain Section, annual meeting in Gunnison, CO
2005 Geological Society of America Rocky Mountain Section, annual meeting in Grand Junction, CO

Innovative Materials/Activities

Developed a new course 'GEOL 113/113L Field-Based Introduction to Physical Geology and Laboratory'. This class is innovative because it uses a weekly geology field trip to teach the material.

Additional innovative Saturday field trips were developed for the 'GEOL 301/301L Structural Geology and Laboratory' and 'GEOL 340/340L Igneous and Metamorphic Petrology and Laboratory' courses

A series of week-long Spring break field trips were developed for the 'GEOL 333 Geology of Canyon Country' course.

New field projects were developed for the 'GEOL 480 Summer Field Camp' course.

Supervision of Student Research/Project(s)

2011, GEOL 497 Structured Research
Project: Geologic mapping of the Gold Star Canyon area, Colorado National Monument
Students: Con Trumbull, Tyrell Kipp, and Geoff Warden

2010, GEOL 497 Structured Research
Project: Geologic mapping of the Liberty Cap area, Colorado National Monument
Student: Tammie Crossen

2008-2009, GEOL 497 Structured Research
Project: "Geological Mapping of the Rabbit Valley Area of the Northern Uncompahgre Plateau, Western Colorado: Training Undergraduate Geoscientists"
Students: Whitney Bonner and Courtney Groff

2007, National Science Foundation-funded Research Experiences for Undergraduates
Project: "A Field-Based Study of Landscape Evolution in Western Colorado"
Description: Geologic mapping of the Little Park Road area.
Students: Nicole Schoolmeesters, Eric Hawes, Whitney Bonner, John Kelley, and Wren Bruce

2005-2006, GEOL 497 Structured Research
Project: "Evaluation of Quaternary-Age Faulting and Laramide-Age Fault Kinematics along the Northern Uncompahgre Plateau, Western Colorado"
Description: Geologic mapping of Laramide and Quaternary age structures in the Bangs Canyon and Ruby- Horse Thief-Bull Canyon area.
Students: Michele Nelson, Andy Darling and Andy Orr

2004-2005
Project: "Evaluation of Quaternary Faulting along the East-Central Uncompahgre Plateau, Western Colorado"
Description: Geologic mapping of Laramide and Quaternary age structures in the Cactus Park area.
Students: James Hodge, John Quigley, Allison Franks, Meredith Harvey, and Alex Garhart

Scholarship and Creative Work, 2003-Present:
Scholarship Related to Discipline

Journal Articles

Jessup, M. J., Karlstrom, K. E., **Livaccari, R. F,** Connelly, J., Amanda, T., and **Rodgers, S.A., 2005,** Complex Proterozoic Crustal Assembly of Southwestern North America in an Arcuate Subduction System: The Black Canyon of the Gunnison, Southwestern Colorado: The Black Canyon of the Gunnison, southwestern Colorado, *American Geophysical Union Monograph,* Volume 154, p. 21 - 38.

Conference Presentation

Trumbull, C., Kipp, T., Warden, G. & **Livaccari, R.**, 2011, Geologic Map & Cross-Sections of the Gold Star Canyon Area, Colorado National Monument, Uncompahgre Plateau, western Colorado, Geological Society of America Rocky Mountain and Cordillera combined Sections meeting in Logan, UT

Swan, M., Horne, J., **Livaccari, R.,** and Keith, S., 2010, Strato-Tectonic Analysis: A Tectonic Integration Tool Used to Link Complex Orogenic Development of the Western U.S. Cordillera to Hydrocarbon: American Association of Petroleum Geologists Rocky Mountain Section, 59th Annual Rocky Mountain Rendezvous, Durango, CO, June 2010

Livaccari, R.F., 2007, Laramide-Age Left-Lateral Strike-Slip Deformation Along The Northern Uncompahgre Plateau, Western Colorado: *Geological Society of America Abstracts with Programs* v. 39, no. 6, p. 195.

Schoolmeesters, N., Hawes, E., Bonner, W., Kelley, J., Bruce, L.W., **Livaccari, R.**, 2007, Laramide-Age Structure Of Little Park Road Monocline, Northern Uncompahgre Plateau, Western Colorado: *Geological Society of America Abstracts with Programs* v. 39, no. 6, p. 307.

Nelson, M., and **Livaccari, R.F.,** 2006, Laramide Strike-Slip deformation along the northern Uncompahgre Plateau, western Colorado: the Bull Canyon-Flume Creek fault system, *Geological Society of America Abstracts with Programs,* Rocky Mt. Section, 58th annual meeting.

Hodge, J. and **Livaccari, R.F.,** 2006, Laramide Strike-Slip deformation along the northern Uncompahgre Plateau, western Colorado: the Cactus Park and Glade Park fault systems, *Geological Society of America Abstracts with Programs,* Rocky Mt. Section, 58th annual meeting.

Nelson, M., Hodge, J. and **Livaccari, R.F.,** 2006, Laramide and Quaternary-Age Faulting along the northern Uncompahgre Plateau, western Colorado, *Geological Society of America Abstracts with Programs,* Rocky Mt. Section, 58th annual meeting, field trip guide.

Livaccari, R.F., and Hodge, J., 2005, Laramide and Quaternary-Age Faulting along the northern Uncompahgre Plateau, western Colorado, *Geological Society of America Abstracts with Programs,* Rocky Mt. Section, 57th annual meeting, field trip guide.

Livaccari, R.F., and Hodge, J., 2005, Laramide and Quaternary-Age Faulting along the Cactus Park-Bridgeport fault of the northern Uncompahgre Plateau, western Colorado, *Geological Society of America Abstracts with Programs,* Rocky Mt. Section, 57th annual meeting.

Technical Reports

Livaccari, R.F., and Hodge, J., 2009, Geologic Map of the Fruita Quadrangle, Mesa County, Colorado: *Colorado Geological Survey*, Open-File Report 09-04.

Other:

Grants

U.S. Geological Survey EDMAP program (Educational Component of the National Cooperative Geologic Mapping Program) 2008-2009 Academic year: "Geological Mapping of the Rabbit Valley Area of the Northern Uncompahgre Plateau, Western Colorado: Training Undergraduate Geoscientists". $7,500

U.S. Geological Survey EDMAP program (Educational Component of the National Cooperative Geologic Mapping Program) 2005-2006 Academic year: "Evaluation of Quaternary-Age Faulting and Laramide-Age Fault Kinematics along the Northern Uncompahgre Plateau, Western Colorado". $6,375

National Science Foundation, Research Experiences for Undergraduates 2005 to 2007 (co-Principal Investigator): "REU Site: A Field-Based Study of Landscape Evolution in Western Colorado". $344,586

U.S. Geological Survey EDMAP program (Educational Component of the National Cooperative Geologic Mapping Program) 2004-2005 Academic year: "Evaluation of Quaternary Faulting along the East-Central Uncompahgre Plateau, Western Colorado". $6,000

Professional Memberships

Member of the Geological Society of America

Service 2003-Present:

University

2003 - 2010 GIS Committee

2005 MSC Faculty Assessment committee

2004 Faculty Salaries & Benefits committee.

Department

2006 - 2012 Geology Club Faculty representative

2003 - 2012 Summer Field Studies Course Coordinator

2003 - 2012 Scholarship Coordinator for the Geology Program

2003 - 2012 Participated in all Geology Program Faculty meetings.

2003 - 2012 PES Scholarship Committee (chairman)

2008 - 2009 Spent a significant amount of time organizing and then moving geology program equipment and mineral and rock samples from SL117-118 during the renovation of the Science building.

2004 PES Courtyard Utilization Committee

2004 PES Tenure Committee

2003 - 2004 Geology Alumni Newsletter Editor

Community

2003 - 2005; 2011 Served as a judge for Preliminary Judging in the March 2003 Western Colorado Science Fair.

2004 Participated in giving the Tope Elementary School Earth Week program by giving several presentations to the elementary school students.

National

2005 - 2008 Served on the U.S. Geological Survey Educational Geological Mapping Program (EDMAP) panel.

Regional
2005 Co-chair of the Technical Program for the May, 2005 Geological Society of America Rocky Mountain section meeting

Advising 2003-Present:

Department level
2006 - 2012 Geology Club Faculty representative
2003 - 2012 Primary faculty advisor for about 45 students in the Geology Program
2003 - 2012 I attempt to recruit new Geology majors from undeclared students in my Geol 113 Field-Based Introduction to Physical Geology course. The weekly field trips allow me to get to know the students on a personal basis and I do my best to persuade students to major in Geology. During this time period I was able to recruit about 6 students for the Geology Program.

Honors and Awards 2003-Present:

Professional Experience:

Please record the number "items/events" you have listed above in the following categories.
If you specify items/events under "other," please provide an explanation/definition.

	Books	**Book Reviews**		**Creative Publications**
1	**Journal Articles**	**Performances**		**Patents**
9	**Conference Presentations**	**Exhibitions**	4	**Grants-funded and non-funded**
	Sabbaticals	**Fullbright**		**Book Chapter**
1	**Other (related to discipline)**			

Name:

Gigi A Richard

Start Year: 2002

Program:
Physical Sciences

Department:
Physical and Environmental Sciences

COLORADO MESA UNIVERSITY

Full-time Faculty Vita

Faculty Rank

○ Professor ○ Assistant Professor

◉ Associate Professor ○ Instructor

Highest Degree

PhD	Colorado State University	Civil Engineering	2001

Education: (List all degrees beginning with most recent-include post docs and external certificates)

Colorado State University, Postdoctoral Research Fellow, 2002

Lincoln University, New Zealand, Postdoctoral Research and Fulbright Fellow, 2001

MS Colorado State University, Civil Engineering, 1997

BS Massachusetts Institute of Technology, Civil Engineering, 1989

Teaching 2003-Present:

Courses Taught

ENGR 140 - 1st Year Engineering Projects
ENVS 101 - Introduction to Environmental Science
GEOL 107 - Natural Hazards and Environmental Geology
GEOL 250 - Environmental Geology
GEOL 305 - Cartography for GIS
GEOL 325 - Engineering Geology
GEOL 355 - Basic Hydrology
GEOL 370 - Renewable Energy
GEOL 375/375L - GPS for GIS with lab
GEOL 394 - Natural Resources of the West
GEOL 415/415L - Introduction to Ground Water with lab
GEOL 455/455L - River Dynamics with lab

Supervision of Student Research/Project(s)

Red Canyon Channel-forming Discharge Study, 2011, with CMU Geology student Greg Indivero.

Scholarship and Creative Work, 2003-Present:

Scholarship Related to Discipline

Journal Articles

Richard, G.A., Julien, P.Y. and Baird, D.C., 2005, "Statistical Methods of Modeling Lateral Movement of the Rio Grande, New Mexico", *Geomorphology*, v. 71, pp. 139-155.

Richard, G.A., Julien, P.Y. and Baird, D.C., 2005, "Case Study: Lateral Mobility Modeling of the Rio Grande below Cochiti Dam, New Mexico", *Journal of Hydraulic Engineering*, v. 131, n. 11, pp. 931-941.

Julien, P.Y., G. Richard and J. Albert, 2004. "Stream Restoration and Environmental River Mechanics", *Proc. First International Conference on Managing Rivers in the 21st Century, Rivers '04*, Universiti Sains Malaysia, Penang, Malaysia, September 21, 2004, pp. 62-78.

Richard, G.A. and Julien, P.Y., 2003, "Dam Impacts and Restoration on an Alluvial River - Rio Grande, New Mexico", Invited Paper at the U.S.-Chinese Joint Workshop on Sediment Transport and Environmental

Studies, Milwaukee, WI, July 21-28, 2002, *International Journal of Sediment Research*, v. 18, n. 2, pp. 89-96.

Conference Presentation

Richard, G.A., 2011, Flash Flooding in the Colorado National Monument: Geomorphic Process and Neighborhood Nuisance, October 31, 2011, Upper Colorado River Basin Water Forum, Colorado Mesa University, Grand Junction, CO.

Richard, G.A., 2011, Historic Channel Change of the Middle Rio Grande below Cochiti Dam, New Mexico, International Conference on the Status and Future of the World's Large Rivers, Vienna, Austria.

Richard, G.A., 2007, Channel-forming discharge on the Dolores River and Yampa River, Colorado, American Geophysical Union, Hydrology Days, Fort Collins, CO.

Richard, G.A. and Anderson, R., 2007, Case Study: Channel-forming discharge on the Dolores River and Yampa River, Colorado, American Geophysical Union, Fall Meeting.

Becker, A., DiPema, L, Ladig, K, Wellik, J, and Richard, G., 2007, Channel morphology and channel-forming discharge of No Thoroughfare Canyon, Colorado, Geological Society of America, *Abstracts with Programs*, Vol. 39, No. 6, p. 306

Richard, G.A. 2007, Flash Flooding History at the Colorado National Monument 1921-2003, Geological Society of America, *Abstracts with Programs*, Vol. 39, No. 6, p. 194.

Technical Reports

Richard, G.A. and Anderson, R.M., 2007, *Channel-Forming Discharge on the Dolores River and Yampa River, Colorado*, Technical Publication No. 44, Colorado Division of Wildlife, 42 p.

Richard, G., 2004. *Flash Flooding at the Colorado National Monument 1921-2003*. Final Report for Association of Women Geoscientists Geologist in the Park Program.

Professional Memberships
American Geophysical Union (AGU)
European Geosciences Union (EGU)

Service 2003-Present:
University
Faculty Senate, Colorado Mesa University, Physical and Environmental Sciences Department Senator (2010 to present)

Tenure and Promotion Committee, Colorado Mesa University, Physical and Environmental Sciences Department Representative (2009, 2010, 2011).

Curriculum Committee, Mesa State College, Physical and Environmental Sciences, Department Representative (2007 - 2010)

Sustainability Council, Mesa State College - founding member of campus organization including faculty, staff and students dedicted to promote, recognize and support sustainability throughout the campus lifestyle, operations and curriculum (2006 - 2009).

Search committees at Mesa State College: Chemistry (2007, 2004, 2003), Construction Management (2007), Physics (2006), Environmental Science (2005)

Faculty Advisor: Western Colorado Action Network (WeCAN) student organization, (2005 - 2007).

GIS Committee, Mesa State College - maintain GPS units and sitewide software license agreement and support GIS curriculum (2003 - present).

Served on the Distinguished Faculty Selection Committee to review nomination for faculty awards (Spring 06)

Served on Graduation Planning Committee - organized volunteers for May 2005 commencement

Department

Organized Search for Director of the MSC/CU Mechanical Engineering Partnership Program, 2009.

Chair of Engineering Search Committee for Assistant Professor - March - May 2010 - 49 applicants, 11 phone interviews, and 4 on-site interviews. Resulted in successful hire of two tenure-track faculty for ME and MET.

Chair of Engineering/CM/Manufacturing Lab Technician position search committee through the summer of 2010. This search failed the first time and was re-advertised and resulted in a successful hire in September 2010.

Served on Chemistry Search Committee for new tenure-track faculty member. Included >80 applicants, 12 phone interviews and 3 on-campus interviews. Search resulted in the successful hiring of one tenure-track faculty members, 2007.

Served on Construction Management Search Committee for new director and faculty member. Included 3 applicants and resulted in the successful hiring of one faculty member, 2007.

Served on Physics Search Committee for new tenure-track faculty member. Included >80 applicants, 12 phone interviews and 3 on-campus interviews. Search resulted in the successful hiring of two tenure-track faculty members, 2006.

Completed major revision of Geology and Environmental Geology curricula, including minor programs, associates, bachelor and teacher licensure degrees. Approved by Curriculum Committee Spring 2005, Culmination of 2 years of work improving the curricula.

Served on Chemistry Search Committee for new faculty member (Spring 2004). Reviewed ~80 applications, 12 phone interviews and 3 on-campus interviews.

Professional

Director, Water Center at Colorado Mesa University (2011 to present)

Organized and coordinated, *Upper Colorado River Basin Water Forum,* October 31, 2011, Colorado Mesa University, Grand Junction, CO.

Manuscript reviewer: *Earth Surface Processes and Landforms* (2010), *River Research and Applications* (2004), *Environmental Management* (2004), *Journal of Hydraulic Research* (2003, 2004), *Global and Planetary Change* (2007).

Texbook Reviewer, Pearson - Prentice Hall, reviewed *Natural Hazards 1st Edition,* Keller and Blodgett (2007).

Field trip chairperson (2005) Geological Society of American (GSA) Rocky Mountain Section Meeting at Mesa State College. Coordinated 11 different field trips throughout Western Colorado and Utah.

Organized symposium "Water Resources in the Colorado River Basin and the Western U.S." as part of the Geological Society of American (GSA) Rocky Mountain Section Meeting at Mesa State College on Monday 23 May 2005 from 8am-12pm. Included water experts from throughout the western United States, including a Colorado State Supreme Court Justice. Open to the public as well as to attendees of the GSA meeting.

Community

Natural Resources of the West Seminar Series, organized every fall semester, 2002 - present.

Community Supported Agriculture Project and Main Street Community Garden Advisory Board, 2008-2010.

Science Fair Judge, Regional Science Fair, Grand Junction, CO, 2002-06, 2008, 2011.

Colorado National Monument Walks and Talks - 100th Anniversary Celebration, Thursday 5/12/11 - presentation at visitor center, and Saturday 5/14/11 - hike in No Thoroughfare Canyon

Watershed 101 presentation, Water Course sponsored by MCWA and Water Center held at Ute Water for ~80 people, Feb 15, 2011

Careers in GIS-T, Presentation for Palisade High School Computer Applications class hour, March 4, 2011.

Colorado National Monument Walks and Talks Series, Flash Flooding at the Colorado National Monument - 1-hour presentations, Thursday 4/16/09, 6:30 pm and Saturday 4/18/09, 3:00 pm.

Presentation for the Fort Collins Audubon Society entitled "Western Colorado's Last Free-Flowing River: The Yampa", 2/14/08 (see attached article).

Presentation for the American Association of University Women in Grand Junction. Presentation introduced MSC's new engineering program, Sat. 11/8/08 (see attached letter).

East Middle School Science Fair Judging, 2/5/08

Presentation for the Palisade Academy at the Gateway Canyons Resort, Gateway, CO entitled "Rivers of Western Colorado: Hydrology and Geology", October 2007.

Developed and taught *Geology Unit* for Girl Scout Troop at New Emerson Elementary School, 2005.

Presentation to the Western Colorado Conservation Corps -at-risk high-school students - about water in western Colorado and in particular related to the work the students doing on trails in western Colorado, 2005.

Developed, organized and taught *River Unit* for 3rd and 4th graders including curriculum and field trip, Deep River School of Expeditionary Learning, 2004.

Developed, organized and taught *Stream Ecology Unit* for 1st and 2nd graders including curriculum and field trip, Tope Elementary School, 2003.

Advising 2003-Present:

University level

Orientation and Advising Sessions

2011 - November 19, 2011
2010 - May 1, May 28, June 4, June 11, July 9, July 16, August 13
2009 - 4/25/09, 7/24/09, 8/14/09 and others
2008 - 4/26/08, 5/3/08, 5/16/08, 12/5/08 and others
2006 - August 11, 2006
2005 - August 16, 2005

Faculty Advisor, Sigma Gamma Epsilon (SGE), student earth-science honor society, (2010 - present)

Faculty Advisor, Western Colorado Action Network (WeCAN) student organization, (2005 - 2007)

Mesa Experience recruiting sessions: Friday, March 26, 2010 and Saturday, April 17, 2010

Mesa Madness - Fall 2004 and February 5, 2005

Department level

Faculty Advisor, Watershed Science Minor program, (2008-present)

Faculty Advisor, MSC/CU Mechanical Engineering Partnership Program and Mechanical Engineering Technology, (2008-2011). Number of advisees varied from 45 to more than 150.

Faculty Advisor, Geology and Environmental Geology (2002-present). Number of advisees averages about ten.

Advising for MavScholars. 2009. Met with six incoming engineering students - 4/15 and 4/17. Prepared advising sheets for three incoming engineering students that I wasn't able to meet with.

Faculty advisor for Engineering Student club. Helped engineering students create an engineering club and get the paperwork organized to submit to CAB (2009).

Graduate committee member, MS Student in Watershed Science, Colorado State University (2007).

Honors and Awards 2003-Present:

Professional Experience:

Please record the number "items/events" you have listed above in the following categories.
If you specify items/events under "other," please provide an explanation/definition.

0	**Books**	0	**Book Reviews**	0	**Creative Publications**
4	**Journal Articles**	0	**Performances**	0	**Patents**
6	**Conference Presentations**	0	**Exhibitions**	0	**Grants-funded and non-funded**
0	**Sabbaticals**	0	**Fullbright**	0	**Book Chapter**
0	**Other (related to discipline)**				

Name:

Harold W Hase

Start Year: 1994

Program:
Physical Sciences

Department:
Physical and Environmental Sciences

COLORADO MESA UNIVERSITY

Full-time Faculty Vita

Faculty Rank

○ Professor ○ Assistant Professor

○ Associate Professor ◉ Instructor

Highest Degree

MS	Michigan Tech University	Geology	1973

Education: (List all degrees beginning with most recent-include post docs and external certificates)

MS Geology Michigan Tech University 1973

BS Geology University of Wisconsin-Milwaukee 1967

Teaching 2003-Present:
Courses Taught
Geol 100, Survey of Earth Science

Geol 111, Principles of Physical Geology- Lecture

Geol 111L, Principles of Physical Geology - Laboratory

Geol 480, Summer Field Camp

Scholarship and Creative Work, 2003-Present:

Professional Memberships
Grand Junction Geological Society
Rocky Mountain Association of Geologists

Service 2003-Present:

Advising 2003-Present:

Honors and Awards 2003-Present:

Professional Experience:

1967 - 1971 Underground Mine Geologist, Exploration Geologist, Calumet, Michigan

1973 - 1982 Exploration Geologist, Senior Exploration Geologist, Inspiration, Arizona

District Geologist, Grand Junction, Colorado

1982 - 1993 Consulting Geologist, Grand Junction, Colorado

Please record the number "items/events" you have listed above in the following categories.
If you specify items/events under "other," please provide an explanation/definition.

Books	**Book Reviews**	**Creative Publications**
Journal Articles	**Performances**	**Patents**
Conference Presentations	**Exhibitions**	**Grants-funded and non-funded**
Sabbaticals	**Fullbright**	**Book Chapter**
Other (related to discipline)		

Name:

Donn N Lorhammer

Start Year: 1995

Program:
Physical Sciences

Department:
Physical and Environmental Sciences

COLORADO MESA UNIVERSITY

Full-time Faculty Vita

Faculty Rank

○ Professor ○ Assistant Professor

○ Associate Professor ◉ Instructor

Highest Degree

MS	Naval Postgraduate School, Monterey,CA	Mechanical Engineering	1989

Education: (List all degrees beginning with most recent-include post docs and external certificates)

MS, Mechanical Engineering, Naval Postgraduate School, Monterey, CA 1989

BS, Meteorology (Cum Laude), University of Utah, 1975
Qualified as Naval Engineering Duty Officer 1991
Qualified for Command of Submarines 1987
Qualified Naval Nuclear Engineer 1981
Qualified in Submarines 1977
Qualified for Operation and Maintenance of Naval Nuclear Reactors 1976

Teaching 2003-Present:

Courses Taught

GEOL 103, Weather and Climate
GEOL 104, Oceanography
GEOL 107, Natural Hazards and Environmental Geology
GEOL 111L, Principles of Physical Geology Laboratory
MATH 090, Elementary Algebra
MATH 091, Intermediate Algebra
MATH 113, College Algebra

Scholarship and Creative Work, 2003-Present:

Professional Memberships

Sigma Gamma Epsilon-Zeta Nu Chapter-Colorado Mesa University-1997-Present

Service 2003-Present:

Advising 2003-Present:

Honors and Awards 2003-Present:

Professional Experience:

Please record the number "items/events" you have listed above in the following categories.
If you specify items/events under "other," please provide an explanation/definition.

0	**Books**	0	**Book Reviews**	0	**Creative Publications**
0	**Journal Articles**	0	**Performances**	0	**Patents**
0	**Conference Presentations**	0	**Exhibitions**	0	**Grants-funded and non-funded**
0	**Sabbaticals**	0	**Fullbright**	0	**Book Chapter**
0	**Other (related to discipline)**				

Name:

David Collins

Start Year: 2006

Program:
Physical Sciences

Department:
Physical and Environmental Sciences

COLORADO MESA UNIVERSITY

Full-time Faculty Vita

Faculty Rank

○ Professor ○ Assistant Professor

◉ Associate Professor ○ Instructor

Highest Degree

PhD	University of Texas at Austin	Physics	1997

Education: (List all degrees beginning with most recent-include post docs and external certificates)

Ph.D. Physics, University of Texas at Austin, 1997
BSc (Hons), Physics, Rhodes University, South Africa, 1989
Postdoctoral Research Associate, Physics, Carnegie Mellon University, 2000-2003
Postdoctoral Research Associate, Electrical and Computer Engineering, North Carolina State University, 1998 - 2000.

Teaching 2003-Present:

Courses Taught

Phys 100, Concepts of Physics
Phys 111, General Physics
Phys 111L, General Physics Laboratory
Phys 112, General Physics
Phys 112L, General Physics Laboratory
Phys 131L, Fundamental Mechanics Laboratory
Phys 132, Electromagnetism and Optics
Phys 132L, Electromagnetism and Optics Laboratory
Phys 230, Intermediate Dynamics
Phys 252, Intermediate Laboratory
Phys 311, Electromagnetic Theory
Phys 321, Quantum Theory I
Phys 396, Topics (Quantum Optics)
Phys 422, Quantum Theory II
Phys 482, Senior Research

Evidence of Continuous Improvement

Workshop for New Physics and Astronomy Faculty, American Association for Physics Teachers (AAPT) , Greenbelt, MD, June 2008.

Innovative Materials/Activities

ConcepTests (short interactive, in-class quizzes involving peer instruction) used during most class meetings for Phys 100, 111, 112, 132. Most of these were developed by myself.

Just-in Time Teaching (reading quizzes due just before classes - responses worked into the class materials) used for Phys 111 and 112. Most assignments developed by myself.

Laboratory packages developed for Phys 111L, 112L, 131L, 132L.

Quantum Theory lecture notes - developed and available to students. Offer a modern coverage of subject - inadequately covered by existing texts.

Supervision of Student Research/Project(s)

Senior research and independent study projects supervised:

2011: Peter Schulze, *"Which-way" experiments with a Mach-Zehnder interferometer.* (Phys 482)
Chris Payne, *Depolarizing channel parameter estimation.* (Phys482)
Jaimie Stephens, *Photon counting.* (Phys 395)
2010: Mitchell Reid and Casey Brown, *Experiments with a Mach-Zehnder interferometer.* (Phys 395)
Peter Schulze and Caitlin Heath, *Construction of an amplifier for a PMT.* (Phys 395)
2009: Jacob Burbank-Goldrich , *Spin-1/2 model for electromagnetically induced transparency (EIT).* (Phys 482)
2008-2009: Allison Cormier, *Wave and particle properties of light in the Mach-Zehnder interferometer.* (Phys 482)
Demetri Falsone, *Polarization interference in the Mach-Zehnder interferometer.* (Phys 482)
2007: Krystyna Dillard-Crawford, *Formulation of the quantum theory of light.* (Phys 482)
2006: Camella Nielsen (Jointly supervised with Warren MacEvoy), *Classical computing with quantum computing devices.* (MATH 494)

Scholarship and Creative Work, 2003-Present:
Scholarship Related to Discipline

Journal Articles

1) "Probing the qudit depolarizing channel," Michael Frey, David Collins, and Karl Gerlach, J. Phys. A: Math. Theor. 44, 205306 (2011).
2) "Discrimination of unitary transformations in the Deutsch-Jozsa algorithm: Implications for thermal-equilibrium-ensemble implementations," David Collins, Phys. Rev. A, 81, 052323 (2010).
3) "Statistical comparison of ensemble implementations of Grover's search algorithm to classical sequential searches," Tomasz M. Kott and David Collins, Phys. Rev. A 77, 052314 (2008).
4) "Polarization requirements for ensemble implementations of quantum algorithms with a single bit output," Brandon M. Anderson and David Collins, Phys. Rev. A. 72, 042337 (2005).
5) "Scaling issues in ensemble implementations of the Deutsch-Jozsa algorithm," Arvind and David Collins, Phys. Rev. A. 68, 052301 (2003).

Conference Proceedings

1) "Quantum Fisher information and the qudit depolarization channel," Michael Frey and David Collins, appears in *Quantum Information and Computation VII*, ed. Eric Donker, et. al., Proceedings of SPIE Volume 7342 (2009).
2) "Discrimination of unitary transformations and quantum algorithms," David Collins, appears in *Quantum Communication, Measurement and Computing (QCMC)*, AIP Conference Proceedings 1110 (2009). Preprint arXiv:0811.1359 (2008).
3) "Shortening Grover's search algorithm for an expectation value quantum computer," David Collins, *Proceedings of the Sixth International Conference on Quantum Communication, Measurement and Computing (QCMC'02)*, Eds J. H. Shapiro and O. Hirota, (Rinton Press, 2003).

Conference Presentation

1) "No Advantage to Entanglement in Bit-Flip Parameter Estimation," David Collins and Michael Frey, Poster presented at the International Conference on Quantum Information, Ottawa, Canada (2011).
1) "Optimal Estimation of Single Qubit Quantum Evolution Parameters," David Collins and Michael Frey, APS March Meeting, Portland, Oregon (2010).
2) "Enhanced Estimation of Quantum Evolution Parameters with Entangled States," David Collins and Michael Frey, APS

Four Corners Section Meeting, Golden, Colorado (2009).
4) "Discrimination of Unitary Transformations and Quantum Algorithms," David Collins, 9th International Conference on Quantum Communication, Measurement and Computing, Calgary, Canada (2008).
5) "Performance Requirements for Ensemble Implementations of Quantum Algorithms," David Collins, Brandon Anderson and Tomasz M. Kott, APS Four Corners Meeting, Logan, Utah (2006).
6) "Polarization Requirements for Ensemble Implementations of Quantum Algorithms with a Single Bit Output," Brandon Anderson and David Collins, APS March Meeting, Baltimore, Maryland (2006).
7) "Statistical Performance of Ensemble Quantum Computers in Search Algorithms," David Collins and Tomek Kott, APS March Meeting, Baltimore, Maryland (2006).
8) "Scaling Issues in Ensemble Quantum Algorithms," David Collins and Arvind, Quantum Information and Quantum Control Conference, Toronto, Canada (2004).

Other

Referee for Physical Review A and Physical Review Letters.

Professional Memberships

American Physical Society

Service 2003-Present:
University

2011
- HLC Accreditation Criterion 3 Committee, member.
- Assessment Committee: PES representative.
- Academic Technology Advisory Committee: member.
- Physics tenure track search, committee member.
- Physics/mathematics seminars presented: 2

2010
- Faculty Senate: PES representative.
- Assessment Committee: PES representative. Attended HLC workshop: "Making a Difference in Student Learning: Assessment as a Core Strategy" in Lisle, IL, Fall 2010
- Academic Technology Advisory Committee: member.
- Physics tenure track search, committee member.
- Physics lecturer search, committee member.
- Campus Calendar Committee: member.
- MSC Graduate Studies Bulletin Working Group: member.
- Exploring a Major Expo, manned PES table.
- Physics/mathematics seminars presented: 3.

2009
- Faculty Senate: PES representative.
- Library Committee, PES/Biology representative.
- Invited and made arrangements for guest speaker, Dr. Dietrich Liebfried (NIST), to give seminar as part of Physics seminar series.
- Chaired a session of the MSC Undergraduate Research Symposium.
- Physics/mathematics seminars presented: 2.

2008
- Library Committee, PES/Biology representative.
- Wubben building committee: member.
- Physics/mathematics seminars presented: 3.

2007

- Library Committee, PES/Biology representative.
- Chemistry tenure track search, committee member.
- Physics/mathematics seminars presented: 3.

2006
- Library Committee, PES/Biology representative.
- Chemistry tenure track search, committee member.
- Physics/mathematics seminars presented: 1.

Department

2011
- Managed library purchases for the physics program.
- Managed the Physics program website and PES departmental website.
- Helped to coordinate physics equipment purchases for upper and lower division laboratories .

2010
- Managed library purchases for the physics program.
- Managed the Physics program website and PES departmental website.
- Helped to coordinate physics equipment purchases for upper and lower division laboratories .

2009
- Managed library purchases for the physics program.
- Managed the Physics program website and PES departmental website.
- Helped to coordinate physics equipment purchases for upper and lower division laboratories .

2008
- Physics program coordinator.
- Managed library purchases for the physics program.
- Managed the Physics program website and PES departmental website.
- Produced content and arranged for production of the Physics program brochure.
- Helped to coordinate physics equipment purchases for upper and lower division laboratories .

2007
- Managed library purchases for the physics program.
- Managed the Physics program website and PES departmental website.

2006
- Managed the Physics program website and PES departmental website.

Community

Regional

Western Colorado Regional Science Fair judge (2007 -- 2010).

Advising 2003-Present:

University level

- 12 SOAR/Advising sessions
- 2 May Scholars events.
- 6 Mesa Madness/Mesa Experience events.

Department level

- 6 graduation audits

Honors and Awards 2003-Present:

Local

Exemplary faculty award for the years 2009 and 2010.

Professional Experience:

Please record the number "items/events" you have listed above in the following categories.
If you specify items/events under "other," please provide an explanation/definition.

	Books	**Book Reviews**	**Creative Publications**
8	**Journal Articles**	**Performances**	**Patents**
8	**Conference Presentations**	**Exhibitions**	**Grants-funded and non-funded**
	Sabbaticals	**Fullbright**	**Book Chapter**
	Other (related to discipline)		

Name:

Chad A Middleton

Start Year: 2006

Program:
Physical Sciences

Department:
Physical and Environmental Sciences

COLORADO MESA UNIVERSITY

Full-time Faculty Vita

Faculty Rank

○ Professor ○ Assistant Professor

◉ Associate Professor ○ Instructor

Highest Degree

PhD	University of Tennessee, Knoxville	Physics	2005

Education: (List all degrees beginning with most recent-include post docs and external certificates)

Ph.D., Physics, University of Tennessee, Knoxville, 2005

B.S., Physics, Eastern Illinois University, 1998

Teaching 2003-Present:
Courses Taught
PHYS 111, General Physics
PHYS 111L, General Physics Laboratory
PHYS 131, Fundamental Mechanics
PHYS 131L, Fundamental Mechanics Laboratory
PHYS 231, Modern Physics
PHYS 321, Quantum Theory I
PHYS 342, Advanced Dynamics
PHYS 396, Topics: General Relativity
PHYS 422, Quantum Theory II
PHYS 473, Modern Optics
PHYS 487, Structured Research
PHYS 494, Seminar
PHYS 496, Topics: General Relativity
EDUC 596, Topics: Middle School Physics

Evidence of Continuous Improvement
"13th Workshop for New Physics and Astronomy Faculty", American Center for Physics, College Park, MD, June 25-29, 2008
"Connecting Student Learning Results to Individual Teaching Goals", January 18, 2008

Supervision of Student Research/Project(s)
April 27, 2011: Three students presented their senior research projects at the Student Showcase
April, 2009: Three students presented their senior research projects at the Student Scholars Symposium
October 23, 2009: One student presented a paper at the Four Corners Section of the American Physics Society Annual Meeting held at Colorado School of Mines
November 10, 2007: One student presented a paper at the Society of Physics Students Zone 14 Annual Meeting held at Mesa State College

Scholarship and Creative Work, 2003-Present:
Scholarship Related to Discipline

Journal Articles

"Anisotropic evolution of 5D Friedmann-Robertson-Walker spacetime", *Physical Review D* **84**, 085013 (2011), gr-qc/1107.1828
"The High Road/Low Road Demonstration or Birds on a Wire", *Journal of Undergraduate Research in Physics*, **22** (Dec. 2009)
"Kayaking Physics: The Tipping Angle", *Journal of Undergraduate Research in Physics*, **22** (Aug. 2009)
"Solutions of Higher Dimensional Gauss-Bonnet FRW Cosmology", *General Relativity and Gravitation*, Vol. 39, Num. 12 (2007) pps. 2061-2071
"AdS/CFT Correspondence with Heat Conduction", *Physics Letters B*, Vol. 654 (2007) pps. 35-40; hep-th/0607139
"Using a Brane to Probe the Bulk", *Mercury*, Journal of the Astronomical Society of the Pacific, Vol. 35 (2006) No. 2
"Constrained Perturbative Expansion of the DGP Model", *Physics Letters B*, Vol. 613 (2005) pps. 189-196; hep-th/0502020
"The Schwarzschild Solution in the DGP Model", *Modern Physics Letters A*, Vol. 19 (2004) pps. 2259-2266; hep-th/0311070

Conference Presentation
"Anisotropic evolution of 5D Friedmann-Robertson-Walker spacetime", *21st Midwest Relativity Meeting*, November 4-5, 2011, UIUC
"Anisotropic Evolution of *D*-Dimensional Spacetime", *APS Four Corners Section Meeting*, October 23-24, 2009
"Anisotropic Evolution of *D*-Dimensional Spacetime", *APS April 2009 Meeting*, May 2-5, 2009, Denver, CO
"Higher Dimensional Gauss-Bonnet FRW Cosmology", *SPS Zone 14 Regional Meeting*, November 10, 2007, Mesa State College
"Dynamical Compactification of *D*-Dimensional Gauss-Bonnet FRW Cosmology, *16th Midwest Relativity Meeting*, November 17-18, 2006, Washington University
"Effects of Dynamical Compactification of *D*-Dimensional Gauss-Bonnet FRW Cosmology", *APS Four Corners Section 2006 Fall Meeting*, October 6-7, 2006, Utah State University
"Constrained Perturbative Expansion in the DGP Model", *APS April 2005 Meeting*, April 16-19, 2005, Tampa, FL
"Constrained Perturbative Expansion in the DGP Model", *8th East Coast Gravity Meeting*, March 19, 2005, Wake Forest University
"The Schwarzschild Solution in the DGP Model", *APS April 2004 Meeting*, May 1-4, 2004, Denver, CO
"Fat Branes in Infinite-Volume Extra Space", *19th Pacific Coast Gravity Meeting*, March 1, 2003, University of Utah

Other:
Grants
Faculty Professional Development Grant, 2007-08
Faculty Professional Development Grant, 2009-10
Faculty Professional Development Grant, 2010-11

Professional Memberships
Sigma Pi Sigma
American Physical Society
APS Topical Group in Gravitation
APS Division of Particles and Fields
American Association of Physics Teachers
Sigma Xi

Service 2003-Present:
University
2011
-- Graduate Curriculum Committee
-- Tutorial Services Advisory Committee
-- Library Director Search Committee
-- Higher Learning Commission Criterion 4 Subcommittee
-- Little Mavericks Learning Center Board of Trustees
-- MSC Student Showcase Judge
2010
-- Graduate Curriculum Committee
-- Tutorial Services Advisory Committee
-- Mechanical Engineering Faculty Search Committee
-- Lecturer of Physics Search Committee
-- Little Mavericks Learning Center Board of Trustees

2009
-- Graduate Curriculum Committee
-- Tutorial Services Advisory Committee
-- Little Mavericks Learning Center Board of Trustees
-- Chemistry Faculty Search Committee
-- Degree Distinction/General Education Committee
-- MSC Student Scholars Symposium Judge
2008
-- Graduate Curriculum Committee
-- Tutorial Services Advisory Committee
-- Distinguished Faculty Award Committee
-- Chemistry Faculty Search Committee
-- Degree Distinction/General Education Committee
2007
-- Graduate Curriculum Committee

Department

2011
-- Faculty Advisor of the Society of Physics Students
-- Chapter Advisor for Sigma Pi Sigma
2010
-- Faculty Advisor of the Society of Physics Students
-- Chapter Advisor for Sigma Pi Sigma
2009
-- Faculty Advisor of the Society of Physics Students
-- Chapter Advisor for Sigma Pi Sigma
2008
-- Faculty Advisor of the Society of Physics Students
-- Chapter Advisor for Sigma Pi Sigma
2007
-- Faculty Advisor of the Society of Physics Students
2006
-- Faculty Advisor of the Society of Physics Students

Community

2011
-- Western Colorado Regional Science Fair Judge
-- MSC SPS Egg Drop Competition, April 23
2010
-- Spooky Science at Western Colorado Math and Science Center, October 30
-- "Gravity, Black Holes, and Cosmology", Western Colorado Math and Science Center Astronomy Camp presentation, August 2
-- "Dark Matter, Cosmology, and Dark Energy", Western Colorado Math and Science Center Astronomy Camp presentation, August 3
-- MSC SPS Egg Drop Competition, April 24
2009
-- Series of physics demonstrations, Mount Garfield Middle School Science Night
-- "Gravity, Black Holes, and Cosmology", Western Colorado Math and Science Center Astronomy Camp presentation, June 22
-- "Scientific Cosmology: A Quest to Comprehend the Universe", Telluride Council for the Arts and Humanities, Astronomy: StarGazing series, June 25
-- MSC SPS Egg Drop Competition, April 25
2008
-- Science Fair Judge, East Middle School Science Fair, February 5
-- MSC Science Fair Physics Demonstrations, February 23
-- MSC SPS Egg Drop Competition, April 5
2007
-- Science Fair Judge, Wingate Elementary School Science Fair, February 8
-- MSC Science Fair Physics Demonstrations, February 24

-- Webelos Guest Speaker, October 23

Regional
2009
-- Session Chair, *Four Corners Section of the American Physical Society Annual Meeting*, Colorado School of Mines, October 23-24

Advising 2003-Present:

University level
2011
-- Soar Sessions: 1
-- Club Advisor: Society of Physics Students
2010
-- Soar Sessions: 2
-- Mesa Experience Sessions: 1
-- Exploring a Major Fair: 1
-- "New to Mesa State" Faculty Orientation: 1
-- Club Advisor: Society of Physics Students
2009
-- Soar Sessions: 2
-- Mesa Experience Sessions: 1
--Club Advisor: Society of Physics Students
2008
-- Soar Sessions: 1
-- Mesa Madness: 1
-- Mesa Experience: 1
-- MavScholars Preview Day: 1
-- Club Advisor: Society of Physics Students
2007
-- Soar Sessions: 1
-- Mesa Madness: 1
-- Club Advisor: Society of Physics Students

Honors and Awards 2003-Present:

National
Society of Physics Students Outstanding Chapter Award, 2010-11
Society of Physics Students Outstanding Chapter Award, 2008-09
Society of Physics Students Outstanding Chapter Award, 2007-08
Society of Physics Students Outstanding Chapter Award, 2006-07
Regional
American Physical Society Topical Group in Gravitation Best Student Presentation, 8th Annual East Coast Gravity Meeting, 2005

Professional Experience:

Please record the number "items/events" you have listed above in the following categories.
If you specify items/events under "other," please provide an explanation/definition.

0	**Books**	0	**Book Reviews**	0	**Creative Publications**
8	**Journal Articles**	0	**Performances**	0	**Patents**
10	**Conference Presentations**	0	**Exhibitions**	3	**Grants-funded and non-funded**
0	**Sabbaticals**	0	**Fullbright**	0	**Book Chapter**
	Other (related to discipline)				

Name:

William M Tiernan

Start Year: 1996

Program:
Physical Sciences

Department:
Physical and Environmental Sciences

COLORADO MESA UNIVERSITY

Full-time Faculty Vita

Faculty Rank

(•) Professor ( ) Assistant Professor

( ) Associate Professor ( ) Instructor

Highest Degree

PhD Institution University of Massachusetts, Amherst Discipline Physics Year 1992

Education: (List all degrees beginning with most recent-include post docs and external certificates)

Ph.D. University of Massachusetts, Amherst, MA, 1986-1992

BA Colby College, Waterville Maine, 1973-1978

Teaching 2003-Present:

Courses Taught

PHYS 111, General Physics I: 2002-2004., 2009-2011
PHYS 112, General Physics II: 2005- 2009
PHYS 131, Fundamental Mechanics: 2005-2007
PHYS 132, Electromagnetism: 2003-2004, 2010-2012
PHYS 231, Modern Physics: 2006, 2010
PHYS 251, Electronics for Scientists: 2004-2010
PHYS 252, Intermediate Lab, 2006, 2007
PHYS 331, Advanced Lab, 2004-2010
PHYS 362, Thermal and Statistical Physics: 2006-2011
PHYS 396, Topics: Frontiers of Low Temperature Physics: 2009
PHYS 421, Advanced Dynamics: 2003-2005

Supervision of Student Research/Project(s)

2010-2011: "Electrical properties of a cold plasma", Brendan Bridge, CMU Student Showcase presentation
2009-2010: "Vacuum system design and construction", Derek Shreck
2004-2005: "Fluctuation Conductivity of Superconducting Melt-Textured Growth YBCO", Joshua Combs, presentation at regional CWAS meeting
2004-2005: "Magnetic Behavior and Critical Currents Neat TC in Melt-textured Growth YBCO", Nicholas Bingham, CWAS presentation

Scholarship and Creative Work, 2003-Present:

Scholarship Related to Discipline

"Magnetization and resistance of melt-textured growth YBCO near Tc and at low magnetic fields", WM Tiernan, NS Bingham, JS Combs, Proceedings of the 24th International Conference on Low Temperature Physics, 2006

Conference Presentation

"Thermal conductivity of superfluid helium in porous vycor glass", presentation at APS 4 corners meeting, October 2009
"Wave Tank Physics", SPS zone conference, November 2007
"Evidence for a percolative superconducting transition in melt-textured growth YBCO", APS regional meeting, October 2005
"Magnetization and resistance of melt-textured YBCO near Tc and at low magnetic fields", poster at 24th International

Conference on Low-Temperature Physics, Orlando FL, August 2005

Professional Memberships

APS, AAPT

Service 2003-Present:

University

Faculty Senate, 2005-2007, Vice President 2006-2007, President 2007-2008

Assessment Committee 2004

Department

Physics Program Coordinator, 2003-2011

Community

National

Regional

Local

Advising 2003-Present:

Honors and Awards 2003-Present:

Professional Experience:

Please record the number "items/events" you have listed above in the following categories.
If you specify items/events under "other," please provide an explanation/definition.

	Books	**Book Reviews**	**Creative Publications**
1	**Journal Articles**	**Performances**	**Patents**
4	**Conference Presentations**	**Exhibitions**	**Grants-funded and non-funded**
	Sabbaticals	**Fullbright**	**Book Chapter**
	Other (related to discipline)		

Name:

Jared C Workman

Start Year: 2011

Program:
Physical Sciences

Department:
Physical and Environmental Sciences

COLORADO MESA UNIVERSITY

Full-time Faculty Vita

Faculty Rank

○ Professor ◉ Assistant Professor

○ Associate Professor ○ Instructor

Highest Degree

PhD	University of Colorado, Boulder	Astrophysics	2010

Education: (List all degrees beginning with most recent-include post docs and external certificates)
B.A. Psychology, Temple University, 2000

B.S. Physics, Mathematics Minor, Temple University, 2003

M.S. Astrophysics, University of Colorado, 2005

Ph.D., Astrophysics, University of Colorado, 2010

Research Scientist, University of Rochester 2010-2011

Teaching 2003-Present:
Courses Taught
Phys 101, Astronomy
Phys 131, Fundamental Mechanics
Phys 131L, Fundamental Mechanics Lab

Evidence of continuous improvement:

Division Plasma Physics, 53rd Annual Meeting, Salt Lake City, November 14th-18th, 2011

Supervision of Student Research:

2011, Supervising Caitlin Heath, Senior, Physics Major, Attending American Astronomical Society Meeting in Alaska, June, 2012

Scholarship and Creative Work, 2003-Present:
Scholarship Related to Discipline

Journal Articles

"Simulations Reveal Fast Mode Shocks in Magnetic Reconnection Outflows", Jared C. Workman, Eric Blackman, & Chuang Ren, Physics of Plasmas, Volume 18, 9, 2011

"Jitter radiation, images, spectra, and lightcurves from a relativistic, spherical blastwave", Brian C. Morsony, Jared C. Workman, Davide Lazzati, (JILA, U. Colorado), Mikhail V. Medvedev (U. Kansas) MNRAS, Volume 392, pp 1397-1402, 2009

"Jitter Radiation In Gamma Ray Bursts and their afterglows: Emission and Self Absorption", Jared C.

Workman, Brian C. Morsony, Davide Lazzati, (JILA, U. Colorado), Mikhail V. Medvedev (U. Kansas) MNRAS, Volume 386, pp. 199-210, 2008

"Interaction of the magnetorotational instability with hydrodynamic turbulence", Jared C. Workman & Philip J. Armitage, The Astrophysical Journal, Volume 685, pp. 406-417, 2008

"Jitter radiation as a possible mechanism for Gamma-Ray Burst afterglows. Spectra and lightcurves", Mikhail V. Medvedev (U. Kansas), Davide Lazzati, Brian C. Morsony, Jared C. Workman (JILA, U. Colorado) The Astrophysical Journal, Volume 666, Issue 1, pp. 339-345, 2007

Unpublished Articles

"Untitled work on low mach number shocks in PIC simulations", Jaehong Park, Jared C. Workman, Eric Blackman, Chuang Ren, and Robert Siller, In Preparation.

"Magnetized Bondi-Hoyle-Lyttleton Accretion in The Galactic Center", Jared C. Workman & Brian J. Morsony, In Preparation

Conference Presentations

"Fast Shocks in Magnetic Reconnection Outflows"', Division Plasma Physics, 53rd Annual Meeting, Salt Lake City, November 14th-18th, 2011

"PIC Simulations of Low Mach Number Perpendicular Shocks Using the Moving Wall Method and Ion Shock Drift Acceleration", Division Plasma Physics, 53rd Annual Meeting, Salt Lake City, November 14th-18th, 2011

Professional Memberships

American Astronomical Society -- 2005 - present

Service 2003-Present:

2011

--Developed Web Site for Physics Department

Advising 2003-Present:

University level

2011:

Soar Sessions: 1

Honors and Awards 2003-Present:

W.W. Smith Scholarship 1998-2000

Murray Greene Award

Presidential Scholars Award 2000 and 2003

Professional Experience:

NON TEACHING EXPERIENCE

Summer 2010 - Spring 2011 *University of Rochester* *Rochester, NY*

Research Scientist

Working to jointly model the large scale reconnection dynamics and slow shock launching in solar flares using parallel MHD solver while probing the particle dynamics in the shocks using PIC simulations. Adapted PIC code OSIRIS to include a moving wall boundary condition. Adapting the results of the multi-scale simulations to generate sub grid models for fluid codes based on kinetic codes.

Spring 2005 - Spring 2010 *JILA - Phil Armitage's Group* *Boulder, CO*

Research Assistant

Simulated accretion disks, Molecular Cloud/Black Hole mergers and Magnetohydrodynamic (MHD) instabilities using numerous Fortran and C based advanced parallel 3-D grid based codes. Studied MHD turbulence and instabilities, variability in accretion disks due to hydrodynamic turbulence and thermal effects, star formation and Bondi Accretion onto black holes. Semi-Analytically modeled the afterglow spectrum in Gamma Ray Bursts incorporating relativistic effects and varying magnetic field topologies. Published in multiple, peer-reviewed journals. Presented several talks to faculty and students. Oversaw the development, implementation and analysis of multiple, concurrent projects.

2004 - 2005 *SWRI - Solar Physics Group* *Boulder, CO*

Research Assistant

Modeled the thermal response of satellite hardware using IDL. Developed image filtering/manipulation routines image and data analysis routines to examine sounding rocket solar images.

Summer 2000 *Physics Department* *Temple University*

Research Assistant

Conducted research and performed computer modeling in project to detect a candidate for dark matter. Responsibilities included object modeling using "Maxwell's 3D Simulator" (an AutoCAD like program designed to measure electrical and magnetic field forces), examining naturally occurring radiation output from a steel containment chamber, and information analysis.

1996 - 2003 *Counselors for Management Inc.* *Abington, PA*

Research Assistant

Worked as an independent contractor assisting in government and industry sponsored projects. Projects involved technical assessment of new and emerging products and processes. Responsibilities included database construction, data analysis, and report creation.

TEACHING EXPERIENCE

Fall 2011 *Physical & Environmental Sciences* *Colorado Mesa University*

Assistant Professor

Professor of physics and astronomy.

Spring 2010 *Science Department* *Front Range Community College*

Adjunct Faculty

Served as primary instructor in for Astronomy 101 - Planets and our Solar System, at Front Range Community College.

2003 - 2010 *Astrophysical Department* *University of Colorado*

Teaching Assistant

Developed review session, exams, and homework assignments. Created a very efficient database driven system to record the grades of hundreds of students from multiple sources.

2001 - 2003 *Mathematics Department* *Temple University*

Adjunct Faculty

Served as primary instructor in introductory mathematics courses at Temple University. Increased the proficiency and taught hundreds of students.

2000 - 2002 *Math & Science Resource Center* *Temple University*

Tutor

Tutored math and physics courses, prepared students for tests and ran final review and recitation sessions.

Please record the number "items/events" you have listed above in the following categories.
If you specify items/events under "other," please provide an explanation/definition.

0	**Books**	0	**Book Reviews**	0	**Creative Publications**
5	**Journal Articles**	0	**Performances**	0	**Patents**
2	**Conference Presentations**	0	**Exhibitions**	0	**Grants-funded and non-funded**
0	**Sabbaticals**	0	**Fullbright**	0	**Book Chapter**
0	**Other (related to discipline)**				

Name:

Anwar Y Shiekh

Start Year: 2010

Program:
Physical Sciences

Department:
Physical and Environmental Sciences

COLORADO MESA UNIVERSITY

Full-time Faculty Vita

Faculty Rank

○ Professor ○ Assistant Professor

○ Associate Professor ◉ Instructor

Highest Degree

PhD Institution: Imperial College, London University Discipline: Theoretical Physics Year: 1987

Education: (List all degrees beginning with most recent-include post docs and external certificates)

Postdoc: Nov. 1988 - Oct. 1989
Department of Physics
University of Waterloo
Waterloo, Ontario
Canada

Postdoc: Jan. 1987 - Nov. 1988
High Energy Physics Group
International Centre for Theoretical Physics
Trieste
Italy
(1987: under scholarship from the Royal Society, London;
1988: under support from ICTP)

Ph.D. 1983-86 Theoretical Physics
Imperial College, London University, London, England
Thesis title: Topics in Path Integration
(Supervisor: Professor C. J. Isham)

D.I.C. 1983-84 Mathematical Physics
(Diploma of Imperial College, Master's equivalent)
Imperial College, London University, London, England

B.Sc. 1980-83 Physics with First Class Honors (~top 5%)
Imperial College, London University, London, England

B.Sc. 1977-80 Mechanical Engineering with First Class Honors (~top 5%)
Imperial College, London University, London, England

Teaching 2003-Present:

Courses Taught

*** Physics**
Modern Optics
Calculus based Physics (University Physics)
Algebra based Physics (College Physics)
Survey of Physics
Introduction to Astronomy

*** Engineering**
Introduction to Engineering

*** Mathematics**
Calculus

Pre-Calculus
Algebra
Discrete mathematics

Evidence of Continuous Improvement
Two publications while here

* Operator regularization of Feynman diagrams at multi-loop order,
  Can. J. Phys., 89, 1149, 2011 while at Colorado Mesa University

* Operator regularization of Feynman diagrams at one-loop order,
  Can. J. Phys., 89, 289, 2011 while at Mesa State College

Innovative Materials/Activities
Got the institution acknowledged in three texts I teach from, for comments made to the authors

* Principles of Physics Optics, C. Bennett (next printing)
bennett@unca.edu

* Physics Concepts & Connections, Art Hobson (6th edition)
ahobson@uark.edu

* The Cosmic Perspective, Bennett, Donahue, Schneider and Voit (7th edition)
jeff@bigkidscience.com

Scholarship and Creative Work, 2003-Present:
Scholarship Related to Discipline

Journal Articles

* Operator regularization of Feynman diagrams at multi-loop order,
  Can. J. Phys., 89, 1149, 2011

* Operator regularization of Feynman diagrams at one-loop order,
  Can. J. Phys., 89, 289, 2011

* A Review of Leading Quantum Gravitational Corrections to Newtonian Gravity.
  (with Arif Akhundov)
  Electr. Jour. of Theor. Phys., 17, 1, 2008

Service 2003-Present:

Advising 2003-Present:

Honors and Awards 2003-Present:

Professional Experience:

Please record the number "items/events" you have listed above in the following categories.
If you specify items/events under "other," please provide an explanation/definition.

Books	Book Reviews	Creative Publications
Journal Articles	Performances	Patents
Conference Presentations	Exhibitions	Grants-funded and non-funded
Sabbaticals	Fullbright	Book Chapter
Other (related to discipline)		

Appendix IV

Course Evaluation Form

Colorado Mesa University Faculty Evaluation
Western Colorado Community College Faculty Evaluation

CRN

Instructor Name: _____ Course: _____ (i.e. ENGL 111) Section: _____ (i.e. 001)

NOTE TO STUDENTS: Your responses are anonymous. The results will not be returned to the professor until AFTER grades have been posted. **IMPORTANT!** This document will be scanned for data entry. Please completely fill in the circle of your selection with pencil or a black or blue pen.

OPTIONAL DATA SECTION: Your responses to the following items are optional.

1. Gender
- Male
- Female

2. Classification
- Freshman
- Sophomore
- Junior
- Senior
- Unclassified
- Graduate

3. Type of Course
- General Education
- Required for Major
- Elective in Major
- Elective Non Major

4. Degree
- Certificate
- AA
- AS
- AAS
- BA
- BAS
- BBA
- BFA
- BS
- BSN
- MA
- MBA
- MSN
- DNP
- Undeclared
- N/A

5. Department of Major
- Art
- Biological Sciences
- Business
- Computer Science, Math, & Statistics
- Health Sciences
- Kinesiology
- Languages, Literature, & Mass Comm
- Music
- Physical & Environmental Sciences
- Social & Behavioral Sciences
- Teacher Education
- Theatre Arts
- WCCC
- Undeclared

6. Expected grade for this course:
- A
- B
- C
- D
- F
- Don't Know

REQUIRED SECTION: Please answer each item as it applies to this class or to this professor, according to the following scale from strongly agree to strongly disagree, and not applicable.

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree	Not Applicable
The course assignments are clear.						
The grading policies/procedures/criteria for this course are clear.						
The teaching methods/techniques used by the professor are effective.						
The exams and assignments of the course are consistent with the course content.						
The course is appropriately challenging.						
The course syllabus accurately reflects the learning outcomes.						
The instructor is well prepared for class.						
The instructor responds to student questions at an appropriate level.						
The instructor uses a variety of teaching methods.						
The instructor explains how material in the course is useful or relevant.						
The instructor is accessible to students during office hours or by appointment.						
The instructor promotes respect and civility for all students.						

Please make comments on the back of this sheet.

Written Comments

Please take the opportunity to make written comments about this class and the professor on this side of the evaluation sheet. Such comments can be useful in helping the professors evaluate their teaching styles and effectiveness.

A. What were the most effective aspects of this course?

B. What changes would you recommend for this course?

C. Are the classroom/laboratory facilities conducive to learning? - If not, please explain

D. Other Comments:

CRN: [redacted] Course: [redacted]
Time: 1400 - 1520 Term: Spring 2012

Instructor: [redacted]

# Evaluations	16
Census Enroll	19
Response Rate	84.21%

Optional Data Section

1. Gender

Male	4	25.00%
Female	10	62.50%

2. Classification

Freshman	10	62.50%
Sophomore	3	18.75%
Junior	1	6.25%
Senior	0	0.00%
Unclassified	0	0.00%
Graduate	0	0.00%

3. Type of Course

General Education	4	25.00%
Required for Major	9	56.25%
Elective in Major	0	0.00%
Elective Non Major	1	6.25%

4. Degree

Certificate	0	0.00%
AA	0	0.00%
AS	0	0.00%
AAS	5	31.25%
BA	3	18.75%
BAS	0	0.00%
BBA	0	0.00%
BFA	0	0.00%
BS	2	12.50%
BSN	3	18.75%
MA	0	0.00%
MBA	0	0.00%
Undeclared	0	0.00%
N/A	0	0.00%

5. Department of Major

Art	0	0.00%
Biological Sciences	0	0.00%
Business	0	0.00%
Computer Science, Math, and Statistics	0	0.00%
Health Sciences	10	62.50%
Kinesiology	3	18.75%
Languages, Literature, and Mass Comm.	0	0.00%
Music	0	0.00%
Physical and Environmental Sciences	1	6.25%
Social and Behavioral Sciences	0	0.00%
Teacher Education	0	0.00%
Theatre	0	0.00%
WCCC	0	0.00%
Undeclared	0	0.00%

6. Expected Grade for this course

A	1	6.25%
B	5	31.25%
C	4	25.00%
D	1	6.25%
F	0	0.00%
Don't Know	0	0.00%

Total Responses	192	
Median of Medians	5.00	
Total Average	4.66	
Strongly Agree	135	70.31%
Agree	50	26.04%
Neither Agree nor Disagree	3	1.56%
Disagree	3	1.56%
Strongly Disagree	0	0.00%
Not Observed	1	0.52%

CRN: [redacted] Course: [redacted]
Time: 1400 - 1520 Term: Spring 2012

Instructo[redacted]

# Evaluations	16
Census Enroll	19
Response Rate	84.21%

Required Section

1. The course assignments are clear.

	N	%
Strongly Agree	12	75.00%
Agree	4	25.00%
Neither Agree nor Disagree	0	0.00%
Disagree	0	0.00%
Strongly Disagree	0	0.00%
Not Observed	0	0.00%
Median		5.00
Mean		4.75

2. The grading policies/procedures/criteria for this course are clear.

	N	%
Strongly Agree	12	75.00%
Agree	4	25.00%
Neither Agree nor Disagree	0	0.00%
Disagree	0	0.00%
Strongly Disagree	0	0.00%
Not Observed	0	0.00%
Median		5.00
Mean		4.75

3. The teaching methods/techniques used by the professor are effective.

	N	%
Strongly Agree	10	62.50%
Agree	4	25.00%
Neither Agree nor Disagree	1	6.25%
Disagree	1	6.25%
Strongly Disagree	0	0.00%
Not Observed	0	0.00%
Median		5.00
Mean		4.44

4. The exams and assignments of the course are consistent with the course content.

	N	%
Strongly Agree	12	75.00%
Agree	4	25.00%
Neither Agree nor Disagree	0	0.00%
Disagree	0	0.00%
Strongly Disagree	0	0.00%
Not Observed	0	0.00%
Median		5.00
Mean		4.75

5. The course is appropriately challenging.

	N	%
Strongly Agree	12	75.00%
Agree	3	18.75%
Neither Agree nor Disagree	1	6.25%
Disagree	0	0.00%
Strongly Disagree	0	0.00%
Not Observed	0	0.00%
Median		5.00
Mean		4.69

6. The course syllabus accurately reflects the learning outcomes.

	N	%
Strongly Agree	11	68.75%
Agree	5	31.25%
Neither Agree nor Disagree	0	0.00%
Disagree	0	0.00%
Strongly Disagree	0	0.00%
Not Observed	0	0.00%
Median		5.00
Mean		4.69

7. The instructor is well prepared for class.

	N	%
Strongly Agree	11	68.75%
Agree	5	31.25%
Neither Agree nor Disagree	0	0.00%
Disagree	0	0.00%
Strongly Disagree	0	0.00%
Not Observed	0	0.00%
Median		5.00
Mean		4.69

8. The instructor responds to student questions at an appropriate level.

	N	%
Strongly Agree	10	62.50%
Agree	6	37.50%
Neither Agree nor Disagree	0	0.00%
Disagree	0	0.00%
Strongly Disagree	0	0.00%
Not Observed	0	0.00%
Median		5.00
Mean		4.63

9. The instructor uses a variety of teaching methods.

	N	%
Strongly Agree	10	62.50%
Agree	3	18.75%
Neither Agree nor Disagree	1	6.25%
Disagree	2	12.50%
Strongly Disagree	0	0.00%
Not Observed	0	0.00%
Median		5.00
Mean		4.31

10. The instructor explains how material in the course is useful or relevant.

	N	%
Strongly Agree	12	75.00%
Agree	4	25.00%
Neither Agree nor Disagree	0	0.00%
Disagree	0	0.00%
Strongly Disagree	0	0.00%
Not Observed	0	0.00%
Median		5.00
Mean		4.75

11. The instructor is accessible to students during office hours or by appointment.

	N	%
Strongly Agree	11	68.75%
Agree	4	25.00%
Neither Agree nor Disagree	0	0.00%
Disagree	0	0.00%
Strongly Disagree	0	0.00%
Not Observed	1	6.25%
Median		5.00
Mean		4.73

12. The instructor promotes respect and civility for all students.

	N	%
Strongly Agree	12	75.00%
Agree	4	25.00%
Neither Agree nor Disagree	0	0.00%
Disagree	0	0.00%
Strongly Disagree	0	0.00%
Not Observed	0	0.00%
Median		5.00
Mean		4.75

Appendix V

Library Assessments and Periodical Lists

Library Program Assessment
John U. Tomlinson Library
Colorado Mesa University

Date of Assessment: November 2012

Purpose of Assessment: Assess library support for Physical Sciences Programs

Program under review: Physical Sciences--Chemistry

Program Level/s: Bachelor of Science

Liaison Signature: _____

1. Collection Assessment

a. Reference Support:
The Reference collection contains 60 titles that use the Library of Congress Subject Heading "Chemistry". More detailed searching using subject headings yields 3 titles covering Analytical Chemistry, 8 for Organic Chemistry, 2 for Inorganic Chemistry, 5 for Biochemistry, and 2 for Physical Chemistry).

b. Monographic Sources
The monographic collection contains 906 titles containing the subject heading "Chemistry"; 175 of these were published since 2000, 106 of which are e-books.
More specific subject heading analysis is as follows:
Analytical Chemistry—136 (16 published since 2000)
Organic Chemistry—172 (22 published since 2000)
Inorganic Chemistry—75 (11 published since 2000)
Biochemistry—167 (49 published since 2000)
Physical Chemistry—150 (25 since 2000)
An additional resource is Prospector, a union catalog of over 30 million items in mostly academic libraries in Colorado and Utah. A quick search of the Prospector catalog using the subject "Chemistry" results in nearly 27,000 items. Most of these items can be delivered to CMU in just a few days.

c. Periodicals
The library also subscribes to the American Chemical Society Web Editions, which includes 41 current chemistry periodicals, as well as the ACS Legacy Archives. Also subscribed is the Journal of Chemical Education. The Science Direct database adds additional chemistry journals. Through the various library databases, students have access to 449 full-text periodical titles that use the chemistry subject heading. An additional 304 chemistry titles have indexing only access.

d. Electronic Resources
Through Oxford Reference Online, the Library has access to several online reference titles: the Oxford Dictionary of Chemistry, Oxford Dictionary of Biochemistry and Molecular Biology, Dictionary of Scientists, and Science, Technology, and Society.

Online journal databases of particular interest include the ACS Web Editions and Science Direct mentioned above, and also Academic Search Complete and Wilson OmniFile.

The Library holds a number of e-books. Of the monographic sources mentioned in part "a" above, the following are e-books, nearly all published after 2000:

Chemistry—117
Analytical Chemistry—12
Organic Chemistry—18
Inorganic Chemistry—5
Biochemistry—41
Physical Chemistry—19

2. Evaluation of the total collection

a. Strengths

The indexing and full text provided by the ACS database, Science Direct and Academic Search Complete allow access to much of the current scholarship in the field and strengthen the Library's support of Chemistry research. While not extensive, the Library's reference and circulating collections sufficiently support coursework for undergraduate Chemistry majors. E-books are a growing resource to support chemistry needs.

b. Weaknesses

The present monographic chemistry collection is weighted by older materials (9% of print materials with the subject heading chemistry were published by 2000 or later). However, if the current influx of e-books are added to this monographic mix, this percentage rises to 19%, thus reducing concerns of an aging collection.

3. Recommendations

The purchase of newer titles in this area should continue, and the current scope of electronic resources should be maintained. Weeding of older materials by the liaison librarian, in close consultation with faculty, should be considered. This department relies heavily on journal literature, and it is important that access to key titles be retained. The chemistry faculty have recently expressed interest in the SciFinder database and further inquiry is being made to determine whether this could be added as a resource.

Library Director: _____ Date: _____

Periodical List for Chemistry

- denotes e-journal
- ✓ denotes print subscription and e-journal

- Accounts of Chemical Research
- ACS Applied Materials and Interfaces
- ACS Catalysis
- ACS Chemical Biology
- ACS Chemical Neuroscience
- ACS Combinatorial Science
- ACS Macro Letters
- ACS Medicinal Chemistry Letters
- ACS Nano
- ACS Synthetic Biology
- ACS Symposium Series
- Analytical Chemistry
- Biochemistry
- Bioconjugate Chemistry
- Bioorganic Chemistry
- ✓ Chemical & Engineering News
- Chemical Research in Toxicology
- Chemical Reviews
- Chemistry of Materials
- Crystal Growth & Design
- ✓ Elements
- Energy & Fuels

- Environmental Science & Technology
- Experimental & Molecular Pathology
- Industrial & Engineering Chemistry Research
- Inorganic Chemistry
- Journal of Agricultural & Food Chemistry
- Journal of Catalysis
- Journal of Chemical & Engineering Data
- ✓ Journal of Chemical Education
- Journal of Chemical Information & Modeling
- Journal of Chemical Thermodynamics
- Journal of Colloid & Interface Science
- Journal of Food Composition and Analysis
- Journal of Medicinal Chemistry
- Journal of Molecular Spectroscopy
- Journal of Natural Products
- Journal of Organic Chemistry
- Journal of Physical Chemistry A
- Journal of Physical Chemistry B
- Journal of Physical Chemistry C
- Journal of Physical Chemistry Letters
- Journal of Proteome Research
- Journal of Solid State Chemistry
- Journal of the American Chemical Society
- Langmuir
- Macromolecules

- Microchemical Journal
- Molecular & Cellular Probes
- Molecular Pharmaceutics
- Nano Letters
- Nitric Oxide
- Organic letters
- Organic Process Research & Development
- Organometallics
- Photochemistry and Photobiology
- Proceedings of the National Academy of Sciences of the USA
- Solid State Nuclear Magnetic Resonance
- Superlattices & Microstructures

11/12

Library Program Assessment
John U. Tomlinson Library
Colorado Mesa University

Date of Assessment: November 2012

Purpose of Assessment: Assessment of Library Support

Program under review: Physical Sciences--Geology

Program Level/s: Bachelor of Science

Liaison Signature: _____

4. Collection Assessment

a. Reference Support:
The Reference collection contains 89 titles with the Library of Congress Subject Heading "Geology".

b. Monographic Sources
The circulating collection contains 26,841 titles concerning the Geological Sciences, including 12,540 government documents and 6,806 maps. Specific areas of the monographic collection (outside of government publications and maps) are as follows:

General works (History, handbooks...)—589
Geology of North America—4539
Geology of western states—1779
Mineralogy—315
Petrology—434
Dynamic and Structural Geology—805
Stratigraphy—371
Paleontology—370
Crystallography—72

An additional resource is Prospector, a union catalog of over 30 million items in mostly academic libraries in Colorado and Utah. A quick search of the Prospector catalog using the subject "Geology" results in nearly 70,000 items. Most of these items can be delivered to CMU in just a few days.

e. Periodicals
The Library has access to 23 current print periodicals in the Geological Sciences, some of which are also available online (Please see attached list of selected titles). Current print title holdings provide an incomplete picture, for the library provides indexing to nearly 600 journal titles with the subject heading of "Geology", over 200 of which have full-text online access.

f. Electronic Resources

The Library supports research in Geology with strong online resources. The GeoRef, and Science Direct databases offer substantial indexing and full text access to periodical literature in Geology. Other electronic resources include the online Dictionary of Earth Sciences, the Oxford Companion to the Earth, and the Dictionary of Weather. There are also 8159 electronic government documents items available from the USGS. The library's SpringerLink e-book collection includes 127 titles where the catalog record contains the Library of Congres Subject Heading "Geology". Additional SpringerLink e-books are retrieved with geology-related subjects such as mineralogy, petrology, etc.

5. Evaluation of the total collection

c. Strengths

The Library has an extensive and growing collection of print resources in Geology. Rapidly growing electronic resources also provide excellent access to current scholarship in the field. The full text and indexing offered by online databases greatly expand the Library's support of research in Geology.

d. Weaknesses

Because of the breadth of resources for Geology, weaknesses in the library resources in this area are not evident. We will continue to work with faculty to identify areas of need. Keeping up with local publications and current scholarship will continue to be a priority.

6. Recommendations

The acquisition of materials in the field should continue, particularly in areas of program concentration, and the scope of electronic resources should be maintained.

Library Director: _____ Date: _____

Periodical List for Geology

• denotes e-journal ✓ denotes print subscription and e-journal

✓AAPG Bulletin

✓American Journal of Science

✓American Mineralogist

• Annual Review of Environment and Resources

Antarctic Journal of the United States (not current)

• Arctic, Antarctic, & Alpine Research

• Climatological Data Colorado

Compass (not current)

Council on Undergraduate Research Quarterly (not current)

• Cretaceous Research

Daily Weather Maps (Weekly Series) (not current)

Earth

Economic Geology

✓Engineering & Mining Journal

✓Environment

Environmental & Engineering Geoscience (not current)

Environmental Geosciences (not current)

• Environmental Science & Technology

EOS

• Estuarine, Coastal & Shelf Science

• Geographical Analysis

✓Geological Society of America Bulletin

✓Geology

✓Geophysics

• Geoscience Canada

Geospatial Solutions (not current)

Geotimes (not current)

GeoWorld (not current)

• GPS World (not current)

• Ground Water

• Ground Water Monitoring & Remediation

• GSA Today

Hydrogeology Journal (not current)

✓Journal of Geology

✓Journal of Geoscience Education

✓Journal of Glaciology

• Journal of Paleontology

✓Journal of Sedimentary Research

Leading Edge

Mineralogical Record

Mining Annual Review (not current)

• Mining Engineering

Mining Journal (not current)

• Mining Magazine

• Monthly Energy Review

Mountain Geologist

• Mountain Research & Development

• Natural Hazards Observer

• Oceanus

✓Oil & Gas Journal

• Pacific Science

Quarterly (Colorado School of Mines) (not current)

Water Well Journal

✓Weatherwise

Woods Hole Currents (not current)

Zeitschrift fur Geomorphologie

✓Zeitschrift fur Geomorphologie Supplements

Library Program Assessment
John U. Tomlinson Library
Colorado Mesa University

Date of Assessment: November 2012

Purpose of Assessment: Assess Library support for Physical Sciences Programs

Program under review: Physical Sciences--Physics

Program Level/s: Bachelor of Science

Liaison Signature: _____

7. Collection Assessment derived using Library of Congress Subject Headings

a. Reference Support:
The Reference collection contains 21 print titles covering specifically the subject of Physics. Additional titles are available: 5 for Mechanics, 2 for Thermodynamics, 2 for Electricity, 3 for Nuclear Physics, and 14 for Astronomy.

b. Monographic Sources
The monographic collection contains about 600 titles covering the subject of Physics (184 of these published since 2000, of which 100 are e-books) Specific areas are as follows:

Mathematical Physics—238 (134 published after 2000)
Mechanics—185 (106 published after 2000)
Thermodynamics—186 (73 published after 2000)
Optics—58 (27 published after 2000)
Electricity—62 (15 published after 2000)
Magnetism—44 (26 published after 2000)
Nuclear Physics—171 (37 published after 2000)
Particles (Nuclear Physics)—151 (70 published after 2000)
Astronomy—372 (161 published after 2000)

An additional resource is Prospector, a union catalog of over 30 million items in mostly academic libraries in Colorado and Utah. A quick search of the Prospector catalog using the subject "Physics" results in about 26,000 items. Most of these items can be delivered to CMU in just a few days.

g. Periodicals
The library subscribes to the Physical Review Online Archive (PROLA) which includes the American Physical Society's archive to the Physical Review Letters Series (I, II, III), the Physical Review Letters, and Physical Review Special Topics. Included are all articles published from 1893 with a 4-year embargo.

An attached list, derived primarily from print journals, and the database, "Science Direct" gives a quick sample of some journal titles we have available. However, any such list is incomplete because through our databases indexing is provided to over 500 journal titles with the subject heading of "Physics". Over 300 of these have full-text online access.
Also available through our databases are journals for the following more specific subject headings:

Mathematical Physics—9
Mechanics—39
Thermodynamics—2
Optics—28
Electricity—13
Nuclear Physics—21
Particles (Nuclear Physics)—5
Astronomy—108

h. Electronic Resources

Indexing to literature in Physics is available through the Science Direct database and additionally through MathSciNet. The Library also has access to several online reference titles: the Oxford Dictionary of Physics, Dictionary of Astronomy, Dictionary of Scientists, and Science, Technology, and Society.
E-books, mostly published by Springer, are also available for the following subjects:

Mathematical Physics—104
Mechanics—93
Thermodynamics—58
Optics—23
Electricity—3
Magnetism—21
Nuclear Physics—30
Particles (Nuclear Physics)—57
Astronomy—131

8. Evaluation of the total collection

e. Strengths

The resources available for Physics provide access to the current research in the field and are sufficient to support undergraduate coursework in the Physics program. The PROLA database adds significant access to physics journals.

f. Weaknesses

Only about 18% of the print collection has been published since 2000. However, if e-books are included in the monographic mix, the currency jumps to 30%. With the current rate of e-book purchases, concern about the age of the print collection becomes less significant. Appropriate weeding of the print collection will help increase the percentage of useful print titles.

9. Recommendations

The purchase of newer titles in this area should continue. Weeding of outdated materials by the liaison librarian, in close consultation with faculty, should be considered. The current scope of the electronic resources should be maintained.

Library Director: _____ Date: _____

Periodical List for Physics

• denotes e-journal

✓ denotes print subscription and e-journal

Ad Astra

✓ American Journal of Physics

• Annals of Physics

✓ Astronomy

• Atomic Data & Nuclear Data Tables

• Icarus

• Journal of Computational Physics

• Journal of Magnetic Resonance

• Journal of Molecular Spectroscopy

• Journal of Research of the National Institute of Standards & Technology

• Journal of Sound & Vibration

• Nuclear Data Sheets

• Optical Fiber Technology

✓ Physics Teacher

Physics Today

• Radiation Research

✓ Reviews of Modern Physics

✓ Sky & Telescope

• Superlattices & Microstructures

Appendix VI

Student Learning Outcome Matrices

Program-Level Student Learning Outcomes for Chemistry

A student who completes the B.S. in Physical Sciences with Concentration in Chemistry will have demonstrated the ability to:

1) Articulate the knowledge base and show fluency with the ideas and techniques of the major fields of chemistry (inorganic, organic, physical, and analytical)
2) Translate chemical problems into mathematical problems, solve these problems using appropriate mathematics, and extract chemically meaningful statements from the solutions
3) Utilize laboratory equipment and experimental techniques to analyze reaction rates and to synthesize, isolate, characterize, and quantify small molecules.
4) Extract experimental procedures from peer-reviewed publications and carry them out using the appropriate experimental techniques and laboratory equipment.
5) Communicate effectively about topics in chemistry verbally and in writing

A matrix linking program-level student learning outcomes (SLO's) with each chemistry course is shown on the next page.

Chemistry Program-Level SLO's by Course

Course	1 Knowledge	2 Computation	3 Lab Competence	4 Literature Utilization	5 Communication
100	X				
121	X	X			
121L	X	X	X		
122	X				
122L	X	X	X		
123	X	X			
131	X	X			
131L	X	X	X		
132	X	X			
132L	X	X	X		
151*					
151L*					
211	X	X			
211L	X	X	X		X
300	X	x			
311	X				
311L	X	X	X		X
312	X				
312L	X	X	X	X	X
315	X				
315L	X	X	X	X	X
321	X	X			
322	X	X			
341	X	X	X	X	X
342*					
397	X		X	X	X
411	X	X			X
412	X	X		X	
421	X			X	X
422	X			X	X
431	X	X			
431L	X	X	X		X
482*					
483*					
494*					

*Inactive course.

BS in Physical Sciences, Concentration in Geology
BS in Physical Sciences, Concentration in Environmental Geology
Program-Level Student Learning Objectives
April 2012

A student who completes the BS in Physical Sciences with Concentration in Geology or Environmental Geology will have demonstrated the ability to:

1) Understand geologic problems, collect and interpret field and/or laboratory data, and test hypotheses (critical thinking and problem solving skills).
2) Conduct geologic studies including data compilation, report writing, and oral presentations (communication skills).
3) Complete field-based studies that involve terminology, concepts, theories, and practices in geology (specialized skills in field geology).
4) Use instruments and technology for measuring and evaluating quantitative data (e.g., field and laboratory equipment, computer software) (technology skills).

Below is a list of Geology courses that provide the basic skills described above.

			Learning Objectives			
			1	**2**	**3**	**4**
GEOL 202	Intro Field Studies		X		X	
GEOL 204	Computer Applications		X	X		X
GEOL 250	Environmental Geology		X	X		
GEOL 301/301L	Structure		X	X	X	
GEOL 321/321L	Remote Sensing		X			X
GEOL 331/331L	Minerals		X	X	X	
GEOL 332/332L	Intro GIS		X			X
GEOL 333	Field Seminar		X		X	
GEOL 340/340L	Petrology		X			
GEOL 355	Hydrology		X	X		
GEOL 359	Energy		X			
GEOL 361	Mineral Resources		X			
GEOL 375/375L	GPS		X			X
GEOL 402/402L	Geomorphology		X	X	X	X
GEOL 404/404L	Geophysics		X			X
GEOL 415/415L	Ground Water		X	X	X	
GEOL 432/432L	GIS		X	X		X
GEOL 444/444L	Sedimentology Stratigraphy		X	X	X	
GEOL 445/445L	Geo Database Design		X			X
GEOL 455	Rivers		X			
GEOL 480	Field Camp		X	X	X	
GEOL 490	Senior Seminar		X	X		

BS in Physical Sciences, Concentration in Physics
Program-Level Student Learning Objectives
April 2012

A student who completes the BS in Physical Sciences with Concentration in Physics will have demonstrated the ability to:

1) Articulate the knowledge base and show fluency with the ideas and techniques of the major fields of physics (classical mechanics, electromagnetism, statistical physics and quantum theory).
2) Translate physical problems into mathematical problems, solve these using appropriate mathematics and extract physically meaningful statements from the solutions.
3) Use laboratory equipment and experimental techniques to investigate experimentally physical phenomena.
4) Communicate effectively about topics in physics verbally and in writing.
5) Execute a project which addresses a significant and complex issue in physics. This project will integrate knowledge and techniques from different areas of physics.

	Learning Objectives				
	1	2	3	4	5
PHYS					
131	x	x			
131L	x		x	x	
132	x	x			
132L	x		x	x	
230	x	x			
231	x	x			
251	x	x	x		
252	x		x	x	
311	x	x			
321	x	x			
331			x	x	
342	x	x			
362	x	x			
422	x	x			
473	x	x			
482					x
494				x	

Final Report

pursuant to

Program Review

2012

Bachelor of Science in Physical Sciences

(Chemistry, Geology, & Physics)

Department of Physical and Environmental Sciences

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Colorado Mesa University

Grand Junction, CO

prepared by

DeWayne Backhus, PhD

External Program Reviewer

Emporia, KS

March, 2013

Final Report

PREFACE

As the external program reviewer, I considered my role to be on behalf of all Colorado Mesa University (CMU) constituents—central administration, the department (its faculty and leadership), others who are part of the CMU academic support infrastructure, and most important, the students who will subsequently graduate and assume roles of responsibility as citizens and contributors to the economy.

The observations gleaned from the CMU Physical Sciences Program Review self-study report and the campus site visit enabled identification of those quality program features that should be reinforced, challenges to be addressed, and ultimately the recommendations offered in this Final Report (Report) for consideration and reflection by the appropriate CMU individuals and/or entities. The result of the program review effort can be programs with the vitality to produce the outcomes envisioned for the physical sciences, namely, chemistry, geology (inclusive of environmental geology and secondary teaching), and physics at CMU.

INTRODUCTION

The Report presents the findings as *observations and impressions* of strengths to be reinforced, and challenges, weaknesses or points for reflection and potential action in-so-far as possible. Observations are accompanied by *recommendations* and *commentary.*

The commentary (comments) is (are) intended to provide a rationale or the basis for the recommendation(s). Suggestions of what is considered "normative," or what some may characterize as "best practices," are also included among several comments. Regarding chemistry, allusions are made occasionally to the American Chemical Society (ACS) Committee on Professional Training (CPT), which passes judgments for "certified" programs (referred to by some as "accreditation"). Professional organizations for geology (e.g., the Geological Society of America, GSA) or physics (e.g., American Institute of Physics, AIP) do not pass judgment so stringently concerning curricula as does the ACS; however, they may suggest curricula, but on a less formal basis.

Some recommendations persist from previous reviews, e.g., substantial reliance on temporary (full- or part-time) faculty, or space constraints for the delivery of lecture and laboratory instruction, for example. CMU, I sense, is acutely aware of these persisting concerns; hence, comments on those recommendations will be more directed to observations and acknowledgments of trends in data or the ostensible and genuine efforts to make progress rather than as the reviewer to simply harangue. Not mentioning such issues and concerns in the Final Report could be construed as an oversight of the somewhat obvious, and lead to the conclusion of a review that was too casual.

Perceived **principal strengths common to all programs**, i.e., chemistry, geology, and physics, are the following:

- A faculty with appropriate credentials that represent a range of institutions including several premier doctoral and research institutions. Most have documented scholarly activity and service contributions during the reporting period; some have exemplary accomplishments.
- An emphasis on the teaching priority. Small classes and out-of-class faculty access provide a supportive teaching and learning environment, particularly at the upper-division, majors' course levels.
- An opportunity for collaborative research projects, either as a program requirement or on a voluntary basis. This enriches the undergraduate experience, and some students, particularly in geology and physics, have received CMU and external recognition for their accomplishments.

Strengths specific to individual programs are considered to be the following:

- Chemistry cites high-quality instrumentation, a situation which was recently augmented by the acquisition of a used, but functional, combination gas chromatograph/mass spectrometer (GC/MS) through private sources.
- Geology capitalizes on a rich geological setting in western Colorado, and emphasizes field-based studies in various courses. The complementary role of the Geographic Information Science and Technology (GIST) and Watershed Science programs provide applied contexts for the discipline (and allied sciences) and related employment opportunities. This combination of circumstances is considered an exemplary program quality.
- Physics cites pride in the teaching imperative, student research opportunities, an active student organization (the Society of Physics Students), and note-worthy student achievements. Outreach involving faculty and students is the norm, also.

Among the principal challenges or weaknesses, or stated another way, circumstances if eliminated or addressed would strengthen all programs, include:

- Space for delivering both lecture and laboratory instruction, but also for laboratory preparations and research projects. Space impediments involve both adequate square footage and proximity to the Wubben Hall and Science Center (WS); ideally available space would be contiguous with the WS.
- Accommodating large student enrollment increases, which have exceeded the capacity to deliver instruction without an increase in the Full-Time Equivalent Student to Full-Time Equivalent Faculty ratio, i.e., FTES:FTEF. This increasing ratio is in spite of tenure-track position additions in recent years.
- Maintaining the existing equipment inventory for laboratory and field-based instruction, and replacing the inventory of laboratory apparatus and field equipment on a scheduled basis.
- The lack of a functional assessment plan (or plans) for documenting student learning more directly to specific program courses and/or features, and ultimately serving as the basis for making informed judgments for program changes, ostensibly improvements.

The following Observations/Recommendations/Comments section alludes to other strengths and challenges. These are the major, highest priority recommendations common to the breadth of program areas. Other, lower priority recommendations with less comment are presented subsequent to the Highest Priority section. The first three below may be considered in priority order.

OBSERVATIONS/RECOMMENDATIONS/COMMENTS: Highest Priority

Observation 1: Faculty "productivity" is high as a consequence of heavy teaching loads, assuming that SCH/faculty averages characterize tenured and tenure-track faculty as well as all FTEF. A considerable reliance on temporary faculty continues.

Recommendation 1: ***All programs can justify additional tenure-track faculty positions***.

Comment: A result of a similar concern ("issue") stated in the 2006 review has been the addition of two tenure-track faculty positions for chemistry (one of which was effective in the fall 2012, which is beyond the review period). Further, as data on p. 27 of the Report narrative and in Appendix II, p. 49 show, there is a trend over the five-year review period for chemistry and physics to have a higher percentage of the SCH produced by tenured or tenure-track faculty; geology was somewhat level for that statistic over the period relative to student credit hours (SCH) generated by faculty type. It is also acknowledged that the fifth chemistry tenure-track position is not reflected in the review cycle data, which would further improve the circumstance for chemistry. However, in spite of additional faculty resources, increased enrollments (generally considered a positive trend) have exceeded the additional instructional capacity.

Two other statistics buttress the case for additional faculty resources. Regarding the FTES:FTEF ratios for the review period (Appendix II, p. 50), although there were approximately four (4) additional FTEF (from 16.8 to 20.6) available, the ratio increased from 17.4 in 2007-08 to 23.5 in 2011-12. To maintain the same ratio in 2011-12 as 2007-08, 27 to 28 FTEF would be required. This would necessitate about six (6) additional faculty (taking in to consideration that one new chemistry hire did not show in the Program Review report data since the appointment was effective in the fall 2012).

Regarding instructional costs (Table 11, page 30), the data suggest a high SCH/FTEF production. Combining SCH and FTEF data for *academic year* 2011-12, the SCH/FTEF varied by program from ~630 (for physics) to ~760 (for chemistry), with a departmental average of ~700. This would average about 350 SCH per faculty member per *semester*, an indicator of high productivity, i.e, potentially a large instructional load where there is no graduate assistant relief, and based on available funds (e.g., work-study) for employment of undergraduate students, little potential relief from that possibility for tasks for which they might appropriately assist.

Those SCH data are reflected by another statistic in Table 11: the $ cost/SCH for the 2011-12 academic year. The reported instructional costs per SCH range from $93

(geology) to $110 (physics); we recognize that geology enrollees underwrite some of the costs with the geology field trip course fees that are assessed. The departmental average is ~$100/SCH, a measure that suggests a very cost effective set of programs based on the following benchmarks (unless CMU peer data might exist for inter-institutional comparisons). One citable source for comparison is 2001 data from a Delaware Study published by the National Center for Education Statistics (*A Study of Higher Education Instructional Expenditures: The Delaware Study of Instructional Costs and Productivity* < nces.ed.gov/pubs2003/2003161.pdf >). To wit, 2001 instructional cost data ($/SCH) for Carnegie comprehensive institutions for, respectively, chemistry, geology and physics are presented using three methodologies. Those data from one analysis are as follows: $181, 144, and 167/SCH; another analysis based on mid-50th percentile program costs gave data of $171, 138, and 163/SCH; and a third analysis based on the Bonferroni statistical procedure displayed average costs per student credit hour of $193, 147, and 181 respectively for chemistry, geology and physics. The patterns of data are similar. And the fact that they predate the CMU data by a decade, they collectively suggest highly productive and consequently cost effective CMU physical sciences' programs. They also provide a persuasive justification for additional faculty resources. Tenure-track rather than full-time temporary positions will also address other challenges, e.g., the aspiration for an ACS-certified chemistry major, provide additional opportunities for mentoring student collaborative research, or enable faculty time to be devoted to "non-instructional" tasks that characterize the professoriate.

Any caveats regarding the recommendation should be tempered with the presumption that the Table 11 instructional cost data are inclusive of all direct costs, and without knowledge of how these physical sciences' instructional cost data compare with other CMU academic program costs per credit hour, or institutional priorities for available funds.

Observation 2: The development and execution of an Assessment Plan (aka Outcomes Assessment) has languished throughout the review period, and perhaps longer.

Recommendation 2: ***Develop and execute an Assessment Plan for each program (concentration or "major").***

Comment: There is evidence of several past iterations of program student learning outcomes (SLOs), sometimes called "objectives" in the Program Review. However, the continuous process of reaccreditation presupposes demonstrable evidence of institutional mission and individual program outcomes attainment at a threshold established by the faculty. Faculty must develop new, or affirm current, measurable student learning outcomes; align outcomes with *direct* measures (those which provide explicit evidence of learning based on student performance, e.g., locally developed measures, nationally standardized examinations, portfolio analyses, capstone experience reports and/or presentations, etc.) and *indirect* measures (those which reflect the learning outcomes or program goals, or serve as secondary indicators of their attainment, e.g., persistence analyses, exit interviews, exit questionnaires, alumni surveys, placement data following graduation, etc.), preferably measures that are both

formative and *summative*; formulate conclusions from the findings of *direct* and *indirect* measures to make informed judgments concerning program decisions; and execute the program changes or make adjustments. The assessment process should engage all faculty to establish "a culture of assessment" as expected by the Higher Learning Commission.

Observation 3: An artifact of CMU history is a physical sciences major and the various program concentrations (chemistry, geology and physics).

Recommendation 3: ***Seek final approval for discrete chemistry, geology and physics designated major programs. (Based on the site visit, this change is "in progress.")***

Comment: CMU *Catalog* copy and departmental program sheets intimate that the current concentrations are equivalent to baccalaureate majors at other institutions; course requirements and site-visit observations corroborate those assertions. This action should facilitate the recruitment of student majors to the programs, and the hiring and retention of faculty. In addition, it can provide a stronger indication of program credibility for graduates as they seek further education or employment.

Regarding chemistry, with the addition of the instrumental analysis course requirement, a strengthened presence of inorganic chemistry, the hiring of a biochemist and subsequent course developments, greater attention to chemical literature and library resources and corollary communications expectations, the curriculum and program elements become congruent with ACS-certified guidelines. Greater impediments for ACS "anointment" appear to be faculty loads (a maximum of 15 contact hours), meeting laboratory-hour expectations (at least 400 laboratory hours beyond the introductory course—see ACS CPT *Guidelines* for clarity on "introductory course"), adequate and proximate space for the delivery of instruction, and access to the ACS *Chemical Abstracts* should ensure that. (Regarding the expectation for *Chemical Abstracts*, investigate whether SciFinder, also a Chemical Abstract Services (CAS) of ACS associated "chemistry information source" can meet the expectation.)

All programs appear to have mathematics requirements at or what might be considered normative. (Chemistry meets ACS guidelines for mathematics for a certified program. Geology requires Calculus I and a statistics course; additional calculus can qualify as an elective.)

As was noted in the previous review, in the ideal ten (10) hours of physics would be required for chemistry and geology program concentrators (majors), and ten (10) hours of chemistry might be expected for physics majors. It appears that CHEM 151/151L (described as a course for physics and engineering students) may have been developed as a hybrid chemistry I and II course, i.e., ten credit hours of typical introductory chemistry topics compressed in to a five-hour course combination for capable students in the allied sciences. However, Appendix II tables (e.g., p. 44) lead to the inference that it is not currently offered. Is there a prospect for a renewed offering of CHEM 151/151L to serve the potential need or desire?

There may have been caveats relative to the recommendation. However, based on information received during the site visit, the previous Colorado Commission on Higher Education minimum major-degree production requirements for the annual numbers of graduates have been suspended. So that constraining factor no longer exists.

Finally, the approval of stand-alone major programs need not require that three new, discrete academic departments be formed (particularly with the numbers of faculty involved). The Program Review report (p. 1) has the following statement: "Although chemistry, geology, and physics are all part of the same degree program and overseen by a single department head, they are managed as independent units. Each program ... and sets its own priorities." This statement may have been intended to validate distinct program concentrations equivalent to majors. Once those are approved as "majors," I suggest that the current administrative structure be affirmed based on potential advantages vis-à-vis faculty, equipment, and other resource and space sharing that can be facilitated by a combined administrative structure. Some extramural funding agencies look favorably upon circumstances that suggest cooperation at the boundary of disciplines. That aside, following a transitional period and demonstrated program maturation and vitality, separate academic units might be justified.

Observation 4: While the numbers of student majors (concentrators) in each program appear to be reasonable (exceeding what the external reviewer considers "normative"), the numbers of graduates, particularly for chemistry, are low.

Recommendation 4: ***Identify strategies to convert students identified as program majors to graduates (particularly chemistry).***

Comment: The SCH production in all programs is commendable. (Yes, a high percentage is at the 100-200 course levels.) Similarly, the number of majors at any given time during the period of review would seem to produce more than an annual average of 3.2 chemistry graduates over the five years, 7.0 geology (plus environmental geology and secondary teaching), and 3.8 physics graduates, the latter of which is considered to exceed the numbers at most baccalaureate institutions based on AIP degree-production data at predominantly undergraduate institutions (PUIs).

Here are some additional observations and inferences that drive the recommendation. Enrollment increases at CMU in general, and specifically in the physical sciences through the review period, have nearly the same percentage distributions of enrollments by course levels (see Program Review, pages 18, 20, and 22). If one compares the SCH production in 300- and 400-level "major" courses for the 2007-08 and 2011-12 academic years, one could project an increase to ~5.0 chemistry graduates per year, 10.0 geology, and ~5.0 physics graduates annually.

Another corroborating observation is the following. Course enrollment data as shown in Appendix II, pages 44-48, for the 300- and 400-level courses required for majors in chemistry and physics have about seven (7) students enrolled. This provides optimism for that annual number of graduates (as was noted by the chemistry faculty based on recent physical chemistry course enrollments). What can be done to convert majors to a greater number of graduates? Is retention the factor?

During the site visit faculty suggested two possibilities that should be explored to address this ostensible issue: greater contact with prospective students that visit campus, and greater participation with academic advising throughout a student's undergraduate career. Students with whom I visited also raised this issue (and the fact that they could enroll without the concurrence of a program advisor); two-thirds of the students considered advising "okay," but the other one-third seemed to think that the current system has shortcomings. This circumstance is particularly true for programs that have a vertically structured curriculum, and if courses are offered on a rotational, or once-an-academic-year basis. Since both faculty and students perceived similar problems, I suggested to students that they request the opportunity to discuss this with faculty, perhaps in "focus group" fashion. See a subsequent point related to this.

As a corollary to this recommendation, an alternative to the retention analysis presented on page 23 of the Program Review should be considered (and could be part of the Assessment Plan). The methodology could investigate "persistence" for each matriculating cohort for subsequent academic years; a given matriculant could be tracked for at least five years. Ten years of tracking would be most instructive to "smooth" some annual, confounding variables. What percentage of matriculants who initially declare a major actually graduate with that major (concentration), or fulfill their education objectives if not as a graduate with the major declared initially? When a student leaves one of the physical sciences' programs, does s/he migrate to another program in the physical sciences (a circumstance which geology characterizes as "opportunistic"), or another at CMU? Or do they leave CMU? Other questions that are potentially instructive could be identified and addressed by the data.

These matters require faculty time to address. With additional tenure-track lines, these are the types of "non-instructional" tasks that could and should be consciously addressed.

Observation 5: There is evidence of current inter- and multi-disciplinary activity, or activity at the boundary of disciplines, e.g., physical sciences courses serving the Environmental Science and Technology major, or biology programs. The Program Review document also suggests that faculty are contemplating alternative program (i.e., major) tracks for the BS degree.

Recommendation 5: ***Continue to explore additional program opportunities, particularly at the boundary of traditional disciplines, and which rely on existing resources in-so-far as possible.***

Comment: Among exhortations of professional organizations of the disciplines (ACS, AIP, GSA) are curricular developments and research opportunities at the boundaries of disciplines. Agencies controlling extramural grant-funding view favorably such efforts when reviewing proposals. Continue to explore opportunities alluded to in the Review narrative or suggested by the following.

Chemistry at CMU, particularly as a consequence of the recent addition of a biochemist, might provide a biochemistry track for the chemistry major, or an opportunity for a

collaborative major with the biological sciences for students who aspire to health-related professions, or the emerging bioscience or biotechnology fields. The Bureau of Labor Statistics in the late 1990s cited three "hot fields" for future employment opportunities: biotechnology, geotechnology, and nanotechnology. CMU geology has geotechnology in the curriculum already; aside from some potential for chemistry with synthesis and the subsequent characterization of molecules (compounds) synthesized, nanotechnology may be elusive at a PUI.

Computational science is a multi-disciplinary program realm that typically merges analytical techniques of mathematics and computer science with chemistry and physics problem contexts. Both faculty and the CMU graduates interviewed alluded to the need for computational science in the curriculum. The conundrum: computational science has diverse connotations.

An engineering curriculum in cooperation with the University of Colorado-Boulder (U of C-B) has been developed—are the physics resources of CMU utilized to the extent possible for the delivery of that? Related, might a dual-degree (or what are sometimes called 2+2 or 3+2) program option be developed whereby a "reverse transfer" of U of C-B engineering courses could fulfill a physics major track set of requirements for a CMU-conferred BS degree? The physics faculty expertise with astrophysics, relativity, and gravitational theory is perhaps the basis for another example of inter-institutional cooperation; physics has entered a partnership with the Air Force Academy (and other institutions) as part of the Falcon Telescope Network. An astronomy-rich physics track could be another possibility.

Observation 6: Program Review and self-study pursuant to accreditation can be times for significant introspection. The Program Review narrative contains a section titled "Vision" (p. 43). The realization of stand-alone majors under the BS degree framework is a consensus goal as an alternative to the existing physical sciences' program concentrations. Several program possibilities are broached for chemistry and geology; others are suggested in Recommendation 5. Does a promising strategy for effecting change exist?

Recommendation 6: ***As the future is contemplated, develop a firm, persuasive vision (or "sense of self") for the physical sciences' disciplines.***

Comment: As the CMU physical sciences' faculty seek new program designations, e.g., majors versus concentrations, and explore alternative major-degree tracks, a strong sense-of-self needs to be communicated to decision-makers. For example, if new faculty lines were made available, can a consensus for placement among the disciplines be communicated? What are discipline-specific priorities for additional resources (not just fiscal, but also space, laboratory furnishings and equipment acquisitions, for example)? Planning can be critical to present a coherent, unified plan, not only to governing bodies, but to fund raisers, alumni, legislators, or other constituencies in a decision-making or resource-acquisition chain to achieve the results desired.

OTHER RECOMMENDATIONS

The following are comparatively minor, secondary recommendations suggested to refine circumstances.

Regarding faculty evaluation, broaden the physical sciences "definition" for the scholarly expectation (department head Russ Walker shared with me the PES "Faculty Evaluation Criteria"). The CMU Performance Evaluation "General Evaluation Criteria" suggests that scholarship should be of a pedagogical nature that "supports classroom instruction" (p. VI-4, CMU *Professional Personnel Employment Handbook*). This seems too parochial; indeed, the PS faculty curriculum vitae indicate something quite different (Program Review, Appendix III) for the actual faculty scholarly activity. Codify and thereby recognize that appropriate pursuits for scholarship reflect Boyer's four-fold taxonomy for faculty scholarly activity: *scholarship of discovery* (traditional investigations of a "pure" science nature), *scholarship of integration* (that of a synthesizing nature), *scholarship of application* (the "applied" in contrast to "pure"), and *scholarship of teaching* (i.e., pedagogical) (Ernest Boyer. 1990. Scholarship Reconsidered. The Carnegie Foundation for the Advancement of Teaching. Princeton University Press). Perhaps the *scholarship of integration* is the most obscure to the reader. The following is a quote from one of the student and faculty (Ryan Baker & Dr. Verner Johnson, Spring 2012) research project posters displayed on the second floor of Wubben Hall: "The Geologic Map of the Grand Valley consolidates published geologic maps from the Colorado National Monument to the top of the Grand Mesa." This characterizes explicitly the *scholarship of integration*. The ACS has also endorsed this four-fold taxonomy as applicable to certified-program faculty.

Regarding CMU Catalog descriptions, review Catalog course descriptions for CHEM, GEOL, and PHYS to ensure accurate and informative copy. Descriptions are somewhat variable in the information conveyed. Some sequential courses, e.g., CHEM 131/131L and CHEM 132/132L are identical with respect to course topic content. Some descriptions indicate the number of lecture and/or laboratory contact hours per week, some do not; some indicate prerequisites, others do not. This maintenance can help program faculty reinforce thinking concerning courses in the curriculum, but more importantly, it can be more accurate and informative to current students, or faculty on other campuses making judgments about CMU students for graduate school, or for others to simply know more when they access the material.

Regarding laboratory-based instruction, such offerings to accompany lecture course counterparts seem to be at a minimum (perhaps based on staffing and space considerations). Reflect on this. For example, course options suggested for preservice elementary education students don't appear to have an option with an accompanying laboratory requirement (PHYS 105/105L Physics by Inquiry lecture/lab, designed for this clientele, apparently has not been taught during the five years of review (Appendix II, p. 47)). "Good practice" in the sciences is characterized by

laboratory-based instruction, especially for this science-anxious clientele that could benefit from a "role model" preliminary to their presence in the classroom.

Related, the ACS requires "... 400 hours of laboratory experience beyond the introductory chemistry laboratory...." (*Undergraduate Professional Education in Chemistry: ACS Guidelines and Evaluation Procedures for Bachelor's Degree Programs*. Spring 2008. p. 11 < http://www.acs.org/cpt >. See also p. 9 for a definition of "introductory" courses.)

Regarding preservice secondary teacher education, investigate the State of Colorado guidelines for licensure for teaching middle and secondary school "science" subjects (inclusive of biology/life science, chemistry, earth science, and physics). If any "major" in one of these sciences will qualify (license) a graduate to teach any of the sciences, ***explore a physical sciences major for secondary-level teaching licensure.*** The presumption is that someone with a broad physical sciences background would have more course work in the breadth of science subjects to which they might be assigned than someone with a single-discipline major who teaches all of the other secondary science subjects (which would be particularly true in the smaller schools where only one or two science teachers are employed).

This recommendation is consistent with a report of the National Governor's Association (NGA) which has the following quote: "A shortfall in the numbers of qualified math and science teachers in the classroom is a chronic problem in the K-12 system; many classrooms are staffed by teachers with neither a certificate nor a degree in their assigned subject area." (p. 5; NGA. December 2011. *Building a Science, Technology, Engineering and Math Agenda: An Update of State Actions*. NGA Center for Best Practices. < http://www.nga.org/files/live/sites/NGA/files/pdf/1112STEMGUIDE.PDF >).

When asked to describe physical sciences concentrators, the faculty cited "diverse" in their backgrounds and capabilities, from "under-prepared" for collegiate-level study to "as good as they are anywhere." When the student interviewees currently majoring in the physical sciences' concentrations were asked for "one suggestion to improve their programs," two students serving as chemistry tutors suggested "increase the mathematics prerequisite for the introductory chemistry courses." Strengthened preservice teacher preparation and more qualified classroom teachers could potentially address the perceived lack of preparedness.

A SUMMARY Of INTERVIEWS With DIRECTORS—Assessment, Information Technology & Telecommunications (IT&T), and Tomlinson Library

All of the directors and their associates interviewed (B. Schans & S. Lay, J. Brown, and S. Cron & B. Borst) indicated that mechanisms and processes exist for dialogue or communications between what they represent and the Department of Physical and Environmental Sciences for the programs being reviewed.

Regarding the status of assessment efforts and the programs, all parties solicited (including the program faculty) characterized assessment (based on a continuum of embryonic, developing, or mature) as being in the *embryonic* to *developing* stages.

In response to the CMU philosophy toward or intent to "go digital," both the IT&T and Library representatives indicated that they are responding as rapidly as possible, but it is a challenge to keep up with technical developments and/or CMU needs and desires. From the reviewer's perspective, IT&T has computer purchasing, computer inventory control (replacement or "pass-along" of machines) and maintenance policies and procedures that are working satisfactorily. "Wireless" capability pervades the campus with few "dead spots." No faculty or students expressed concerns in this realm.

Discussions with the Library representatives focused on SciFinder and ACS *Chemical Abstracts* desired by the chemistry faculty, and the expectations for an ACS-certified program vis-à-vis chemical information sources. Other points related to "going digital" included support for online courses and the formats for Library holdings (the campus has been informed that generally only one format, not multiple formats, will be possible). Inter-library loan, the Prospector courier service, and Alliance purchasing were also among points discussed. Director Cron and Borst concurred with the CMU Wikipedia entry that asserts that Tomlinson Library has a "world class geology library." Unfortunately, I did not have the geology faculty respond to that assertion!

A SUMMARY Of CLASS VISITS

Two classes were visited: GEOL 107 Natural Hazards and Environmental Geology, a lecture course for students to meet a general education natural sciences requirement (taught by Professor Andres Aslan), and CHEM 312 Organic Chemistry II, a chemistry majors' and allied sciences service course (taught by Professor Joe Richards).

The subject of the day for the GEOL 107 course was "Slope Hazards," inclusive of rock slides to debris flows as the basis for the mass movement of material down slope. The lecture presentation consisted of PowerPoint projections of dramatic case examples of the specific hazards discussed (e.g., Redlands, Glenwood Canyon, Colorado National Monument, St. George, Utah, etc.), which was punctuated with hand-written, document-camera projections of bullet points of conceptual aspects or associated processes and controlling forces (e.g., "relief is the key," or "gravity is the driving force," etc.), or key words (e.g., "colluvium"). Aslan was soft-spoken and deliberate with the delivery, allowing time for note-taking, occasionally soliciting for questions, or otherwise providing an opportunity for participation (three or four students of the approximately 20 present did so). Verbal and visual cues were provided to focus students' attention on salient "take-away" points. In my judgment, classes like this characterize the "opportunistic" nature of geology for acquiring students as program concentrators (majors).

The subject of Professor Richards' presentation was "Nucleophilic Aromatic Substitution." The manner of presentation was very interactive and engaging of students. Rhetorical questions were often used to focus attention; other questions often

elicited a choral response from the approximately 40 students in attendance. The ubiquitous benzene ring-based structures were drawn on the white board using multiple marker colors to distinguish bonding sites, electron affinities, anion intermediates, etc. Other effective pedagogical strategies included references to previous course content (including Organic I), a show of hands to a question with a binary-response option, solicitations for predictions of substitution sites or reaction rates of various halogens, and the basis for students' reasoning in response to questions. Summaries were presented to reinforce salient points. In addition to Richards' barrage of questions and students' choral participation, at least three students initiated questions. Considerable humor also attended the discourse. Given that the class day was a Friday, the last ~15 minutes of the period were used for a quiz over recent material. While students were responding to the single-page, five-question quiz, Richards returned a set of papers to students on a one-by-one basis. He obviously knew the names of all students.

Although the two classes were intentionally selected to be different and complementary of each other (different course levels, disciplines, student clientele, and pedagogical styles), both were considered to be quite effective for the ends desired. [Note: I have observed in excess of 100 different classes of professors in all of the physical sciences' disciplines, and courses at all levels. In that context the two classes are rated in the upper ten percent of those observed during my career in an administrative capacity.]

A SUMMARY Of INTERVIEWS With CURRENT STUDENTS And GRADUATES

Students

The two student group sessions had a combined total of 17 students, with four representing chemistry; six, geology; six, physics; and two were in the CU-B mechanical engineering program (and also seeking a physics minor). (The total programs represented, 18, exceeds the total students because one student was a double major.) Five of the students were females, and 12 were males.

Their responses to a query of "the most positive aspect of their presence at CMU—either the major or across campus?" were as follows:

- A cluster of related points: small classes (beyond introductory), a desirable student:teacher ratio, faculty interested in teaching (i.e., the general enthusiasm of faculty), knowing professors (a "personable" faculty), faculty who were accessible out-of-class, and similar other comments;
- Recent upgrades in facilities;
- Field-based courses; and
- Research opportunities, and encouragement to attend and present at professional meetings (as well as on-campus).

In response to "If you could change something, what would you recommend for change, i.e., the negatives?", students suggested the following.

Regarding their programs:

- In spite of new facilities, space needs exceed capacity (and classes then are scheduled outside of Wubben Hall-Science Center, or laboratories become multi-purpose areas, or research/project space is limited);
- Need for equipment maintenance and/or upgrades;
- Lack of student preparedness in mathematics for introductory courses (expressed by chemistry tutors);
- Geology online-course option(s) for general education eroding course fee budget for field trips; and
- Provide a "technical writing" course option for Composition II.

Regarding CMU suggested changes for which some consensus exists included:

- Provide proportionally more fiscal resources for construction of academic space (versus non-instructional space);
- Prioritize expenditures to support academic programs (based on a perception that the proportion of fiscal resources to other entities is large in contrast to academics, and that significant contributors, e.g., geophysical exploration and energy companies, that have a kinship to STEM majors are contributors from which they don't benefit proportionally); and
- Issues with the CU-B mechanical engineering program, i.e., questions of continuing scholarship support, and the Accreditation Board for Engineering and Technology (ABET) accreditation of the program.

Related to the previous, when I asked if avenues exist for expressing dissatisfaction (whether course evaluations or an atmosphere conducive to such), the answer was "Yes, but nothing seems to happen." I encouraged them to seek opportunities to engage in dialogue, but be respective of other perspectives.

Regarding faculty teaching effectiveness and teaching styles/methods, students suggested that it varies by course level. Introductory-level courses are most often characterized by lectures using PowerPoint projections. Upper-level courses often have less PowerPoint use and more active-learning strategies and opportunities for participation (e.g., board work to present problem solutions). This diversity was characterized as "okay." Related, while some students in one of the focus groups were disenchanted with a course required for one of the physical sciences' concentrations (and taught by a professor from another department), when I asked about faculty teaching styles and teaching effectiveness in general, one student stated that "it is surprising to have a professor that [I] don't like." Others concurred.

About one-third intimated concerns of varying degrees with advising—they criticized the lack of accurate information from the "center" and its advisors, and the need to interact with an informed advisor (preferably faculty in their programs) before processing an enrollment on a semester-to-semester basis. I suggested that they pursue this with the faculty with some urgency. As external reviewer, I assert that with vertically structured curricula that advising is critical to satisfactory progress toward graduation, that it can enable greater retention in the concentrations (majors), and that it can assist students with "the next step" following their graduations. Although I do not include this as an

explicit recommendation, those in a position to reflect upon this and realize change should do so.

I closed the student sessions with a query concerning post-graduation plans (all but six were seniors). Three indicated graduate school as the aspiration (two chemistry and one physics—one of the chemistry is also a geology double major), nine indicated employment (including one chemistry planning to teach at the secondary level), two geology students suggested a USGS internship, and three (one chemistry and two physics) indicated uncertainty. The Program Review report leads to the conclusion that more careful tracking of students on their "next steps" following graduation is needed, i.e., data on pages 24-25 of the Review document suggest that the post-graduation status of 23 of the 81 physical sciences graduates in the five-year period of review was unknown. That could be a potential element of the Assessment Plan for programs.

Graduates

Three students were available to represent past graduates of the programs: two female and one male; two geology and one physics. One had just completed a PhD in geology, is currently contracted at CMU as a part-time faculty member, and is interviewing for a tenure-track position in academe. Another geology graduate, following a period of private-sector employment in the region, has returned to CMU to pursue a second bachelor's degree major in physics. A spring 2012 physics graduate is now a student in the astronomy and planetary science program at the University of Colorado-Boulder.

Responses to a question concerning their CMU program concentration strengths paralleled those responses indicated in the Program Review, as confirmed by faculty at the site-visit session, and as cited in this Report previously.

Regarding their advice to improve "the educational experience" at CMU, or in their programs, the following were the consensus. For geology, more focus on the quantitative aspects of the subject, and the need for equipment upgrades, including software. Regarding the perception for physics, a computational science need was cited (see previous regarding this point). These suggestions generally converged with the Program Review narrative, and views and opinions expressed by faculty.

CONCLUDING COMMENTS

Colorado Mesa University is commended for undertaking program reviews with an external review dimension. While such a strategy necessitates substantial faculty work to compile a report and engage with introspection, which can be time-consuming and generate anxiety for the individuals most directly involved, it should provide the basis for strengthened programs during a time of considerable societal oversight and intrusiveness in campus affairs. May the result of conscious, internally driven reviews of programs at CMU be the basis for program vitality and institutional pride. These types of reviews can join with other initiatives to enable CMU to embark with confidence "on the next step" toward its vision as an institution.

Table: Executive Summary Template for External Reviewer's Observations

Program Review Element	Check the appropriate selection				Provide explanation if not agree with element and/or why unable to evaluate
	Agree	Not Agree	Unable to Evaluate	Not Applicable	
The program's self-study is a realistic and accurate appraisal of the program.	X				
The program's mission and its contributions are consistent with the institution's role and mission and its strategic goals.	X				
The program's goals are being met.	X				See note (1) below table.
The curriculum is appropriate to the breadth, depth, and level of the discipline.	X				
The curriculum is current, follows best practices, and/or adheres to the professional standards of the discipline.	X				
Student demand/enrollment is at an expected level in the context of the institution and program's role and mission.	X				
The program's teaching-learning environment fosters success of the program's students.	X				
Program faculty members are appropriately credentialed.	X				
Program faculty members actively contribute to scholarship, service and advising.	X				
Campus facilities meet the program's needs.	X				See note (2) below table.
Equipment meets the program's needs.	X				See note (3) below table.
Instructional technology meets the program's needs.	X				See note (4) below table.
Current library resources meet the program's needs.	X				See note (5) below table.
Student learning outcomes are appropriate to the discipline, clearly stated, measurable, and assessed.		X			See note (6) below table.
Program faculty members are involved in on-going assessment efforts.		X			See note (7) below table.
Program faculty members analyze student learning outcome data and program effectiveness to foster continuous improvement.		X			See note (8) below table.
The program's articulation of its strengths and challenges is accurate/ appropriate and integral to its future planning.	X				See note (9) below table.

(from CMU Program Review Manual_ 2012) September 7, 2012

Following are the Table notes as caveats or qualifiers for the Table entries:

(1) Yes, however, additional program goals could be articulated such as the delivery of service courses for allied science majors, or course delivery for general education; however, goal number 4 on p. 2 of the Program Review may subsume general education offerings. All goals as stated are considered to be addressed and met.

(2) Currently laboratory space is limited. Physics is an example vis-à-vis introductory and advanced labs. Additional laboratory space (without staffing constraints) could provide more opportunities for general education laboratory-based instruction. Lecture classes are sometimes scheduled in classrooms across campus.

(3) Reviewer concurs, but maintenance and laboratory equipment inventory control (replacement on a scheduled basis) are challenges.

(4) Instructional technology in this context is understood to be computers in classrooms with digital projectors for PowerPoint projections, for example, but laboratory equipment for instruction can benefit from upgrades.

(5) Chemistry's aspiration for ACS-certified status would necessitate access to *Chemical Abstracts*. Pending that, current resources can suffice. See Final Report narrative.

(6) Student learning outcomes (SLOs) based on the latest iteration are "on target"; however, some are not in "action verb" language. Hence, they are not clearly measurable. Little data exist (except for some ETS Major Field Test data for chemistry and physics, ACS standardized, and locally developed geology testing), consequent findings, and targeted changes in an on-going cycle and on a sustained basis have not become part of the culture; see Recommendation 2 in the Report.

(7) Perhaps "Unable to Evaluate" would have been an appropriate response. Reviewer had the perception of a faculty "willingness," but uncertainty existed relative to "What is an appropriate and productive strategy for addressing assessment as a genuine factor to improve programs and demonstrate SLO achievement at acceptable thresholds established by faculty?" [This is not to detract from the anecdotal evidence of student successes indicated by student research projects and subsequent recognition and awards.]

(8) See above, numbers (6) and (7).

(9) Such in the Program Review report was corroborated by current students in the programs and the graduates interviewed in "focus group" fashion, and also the faculty and other CMU constituents interviewed as individuals or in groups.

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TO: Steve Werman, Assistant Vice President
Academic Affairs

FROM: Russ Walker, Head
Department of Physical and Environmental Sciences

DATE: April 22, 2013

SUBJECT: Comments on External Reviewer Report for the B.S. in Physical Sciences (Chemistry, Geology, and Physics)

We appreciate the insightful comments provided by our external reviewer, Dr. DeWayne Backhus, and agree with his observations and his evaluation of our strengths, weaknesses, and challenges. We also agree that implementation of his recommendations will improve our programs. We offer the following comments on selected recommendations.

Recommendation 2—Develop and execute an assessment plan for each program. Although we have struggled with this in the past, the new campus-wide framework for student learning outcomes and assessment will be an asset. We have drafted assessment plans that will be finalized for implementation beginning in August 2013. We are committed to carrying out these plans and using the assessment results to make program improvements.

Recommendation 3—Seek final approval for discrete chemistry, geology, and physics designated major programs. This action was in progress at the time of the reviewer's visit, and needs only final approval from the Board of Trustees to take effect.

Other recommendations—Regarding faculty evaluation, broaden the physical sciences "definition" for the scholarly expectation. The reviewer's reading of the handbook definition for scholarship may be overly narrow. Most members of the physical sciences faculty engage in research that advances knowledge in their discipline, rather than focusing on pedagogical research, and are rewarded for doing so through the performance evaluation system.