The University of New Mexico

Academic Program Review

Department of Earth & Planetary Sciences

[Peter Fawcett, Chair Earth & Planetary Sciences]
Fall/Spring 2020_2021

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Criterion 1. Introductory Section & Background Information

The section should provide a brief introduction to the Self-Study Report, which includes the following elements:

1A: Summary *An Executive Summary that provides a one to two-page summary/abstract of the information contained within the Self-Study Report.*

The Department of Earth and Planetary Sciences excels in research, teaching and service, and the excellence of the Department faculty and students has earned us an outstanding national and international reputation. We are the highest ranked STEM department at UNM (46th in the country according to the US News & World Report), and we are one of the top-ranked departments at UNM in terms of F&A return per faculty. Our faculty and students are internationally recognized for their scholarship and teaching, with several faculty members recognized as Fellows of several geological and scientific societies and some faculty members earning teaching excellence awards. Our research areas span the full complement of Earth, Planetary and Environmental Sciences, from the deep interior of the Earth (mineral physics, geophysics), to the surface (sedimentology, paleobiology, surface processes, hydrology, geochemistry), the atmosphere (climatology, paleoclimatology) and to the solar system (meteoritics, lunar and planetary science). Department faculty and students study the Earth System from its formation and early evolution to the modern and how future climate and environmental change will impact us. Our research facilities are world class and have attracted significant external funding and collaborations with UNM partners and scientists outside the university.

The department is very successful at raising a significant part of its research, teaching, and student support budget from outside sources. We are highly successful at raising contracts and grants from federal and state agencies (especially NSF and NASA), obtaining large equipment grants to improve on our already state-of-the-art facilities (some of these with UNM cost match and some without). We have very strong alumni support with recent large gifts supporting undergraduate student scholarships, graduate student fellowships and summer support, an endowed lecture series, and many large unrestricted gifts that have allowed us to negotiate faculty hires sooner (bridge funding) than would have been allowed under the College 5-year hiring plan. We have been very successful in raising State capital improvement funds for the new Natural History Science Center (the old Biology Annex building), for our Silver Family Geology Museum renovation, and for extensive renovations to labs in the basement of Northrop Hall for new faculty.

At the same time, we are experiencing significant cutbacks in UNM funding for our operations. Because of the recent hiring freeze and budget cuts, we have struggled to replace essential technical staff members for our facilities (e.g. the Transmitting Electron Microscope (TEM) facility lost two PhD level staff members; it took years to replace our Harding Mine technical staff member putting the University at significant risk for liability; and our growing Geophysics group is severely handicapped by a lack of technical computing support). We will be losing two graduate TA positions in the next fiscal year, and will therefore be using more alumni support to keep our graduate program strong and healthy. In short, it has become necessary to fund an

increasing share of our operations from outside sources and become less dependent on UNM support, a position that will be difficult to sustain.

The department offers several degrees including 3 at the undergraduate level; a B.S. in Earth and Planetary Sciences, a B.A. in Earth and Planetary Sciences, and a B.S. in Environmental Sciences. Two graduate degrees include an M.S. and a Ph.D. in Earth and Planetary Sciences. We recently restructured our B.S. in Environmental Sciences with a new sequence of core classes and we plan to add a B.A. in Environmental Sciences with fewer required math supporting classes. Like other geoscience departments across the country, we are seeing a decline in our undergraduate enrollment numbers over the last 5 years. Changes in the State of New Mexico and UNM graduation core lab science requirements have significantly reduced enrollment in our introductory-level courses (Physical Geology and The Blue Planet). Since these courses are important for recruiting students to our degree programs, we have also experienced lower enrollments in our upper-division courses. The Environmental Science major has seen a recent increase in enrollments. Our graduate enrollments have remained relatively stable. The Department has a strong tradition of graduate student mentorship and training resulting in a noteworthy track record of success in graduate student research, funding, peer-reviewed publications, and Ph.D. placements are research universities and high quality colleges.

Faculty and students are very active in professional societies, outreach, and other service activities. We collaborate extensively with other UNM departments and colleges, local national labs including Sandia and Los Alamos, and with researchers at other institutions. The Department maintains a broad spectrum of world-class analytical facilities which support our research activities and these are expanding – both into the new PAIS building and through the renovation of the old Biology Annex into the new Natural History and Science Center.

The University of New Mexico faculty have recently voted to unionize and as negotiations with the administration are ongoing, it is unclear what this will mean in terms of faculty teaching loads, salary raise determinations, and other aspects of faculty life. The staff have a separate union, and the graduate students at UNM are currently undergoing a unionization effort.

1B: History *A brief description of the history of each degree/certificate program offered by the unit.*

The Department of Earth and Planetary Sciences is among the oldest departments on the UNM campus. The Department was established after the foundation of UNM, when Dr. C. L Herrick arrived to assume the position of second president of UNM and its first professor of geology. During its 115-year history, the Department has had as many as 24 faculty members (currently 18 faculty members in January 2021), a significant number of research scientists, more than 125 undergraduate, masters and doctoral students, and numerous staff members. This growth mirrors the growth of the University from a small, mainly college preparatory school of fewer than 100 students to the large, multifaceted institution it is today. The Department graduated its first undergraduate student in 1901, but the early years of the development of the Department were slow and hampered by a variety of problems including the departure of key faculty and complete loss of the building that housed the Geology Department due to a fire in 1910. During this time,

the UNM faculty grew slowly; in 1925, for example, there were only a total of 29 faculty at UNM, and Geology, Biology, Mathematics and Physics were all Departments with just one faculty member each. During the early years of the Department, up until the late 1930s, the Department graduated a small number of students (~42) with B.S. and B.A. degrees. An important turning point came in 1928 with the appointment of a second faculty member, Dr. Stuart A. Northrop, as acting and then permanent Department chair. Under Dr. Northrop's leadership, a master's degree program in geology was established with the first student graduating in 1930. During the 1930s, the Department saw a progressive increase in its graduating students (undergraduate and graduate) that faltered during the Second World War due to the overall decrease in student enrollment at UNM. The major period of growth in the undergraduate program in Geology commenced after the Second World War when the strategic significance of natural resources became an imperative for the nation. This post-war surge in interest in geology catalyzed efforts by the Department to make three major areas of growth important priorities for the University: the construction of a building to house the Geology Department; the addition of new faculty; and the establishment of a doctoral program. During this period, the development of this unit as an important science department on the UNM campus can be attributed to the significant efforts of Dr. Northrop and Dr. Vincent Kelley, a graduate of Caltech who was hired 1938. From the mid-1940s through to the 1960s, these two individuals had an immense impact on the successful growth and evolution of the Department, laying the foundations of the modern Department that exists today.

The new Geology building, Northrop Hall, was completed in June 1953, but the addition of new faculty was a slower process. The Geology Department experienced major changes and expanded considerably during the 1960s, and by 1971, nearly all of the major elements that characterize the present Department were in place. Seven new faculty positions were added during this period, doubling the Department's size and vastly increasing its disciplinary diversity and research potential. The Institute of Meteoritics (IOM), which was formerly part of the Department of Physics and Astronomy became attached to the Geology Department in 1967 and began an unprecedented expansion into the study of extraterrestrial materials. This effort was led by Dr. Klaus Keil who was appointed Director of the IOM in 1968 and was driven by the return of lunar samples by the NASA Apollo missions. An initiative to develop a materials analysis center in the Department was proposed by Vincent Kelley in 1967 and that set in motion major efforts to establish a series of analytical laboratories that would house expensive analytical instrumentation. This vision established a fundamental and key aspect of the Department that successive faculty have continued to build on the present day, starting off with the acquisition of an electron microprobe in 1968. These efforts coincided with an acceleration in the support of scientific research at universities by federal agencies.

In the late 1990s, in response to the changing interests of students entering geosciences program towards more environmentally oriented curricula, the Department made the decision to introduce a B.S. in Environmental Sciences. This program was approved by UNM in 2000 and the first students graduated in 2003. The introduction of this program has brought challenges to the Department because it was introduced with no extra resources, using existing faculty and teaching assistants to teach the additional classes. The program has been successful, attracting a significant number of students (especially minority students) and increasing the number of students that have graduated from the Department over the last 10 years. The Environmental

Science degree underwent a significant revision in 2014-2016 in response to student requests and a desire on the part of the faculty to structure the ENVS degree in a manner similar to the EPS degree with more core classes. We also wanted to form cohorts of students and increase a sense of place in the degree. The restructuring of the degree included the development of four new core classes (more in the curriculum section) and reducing the number of electives, but keeping a strong core science requirement. At the time of the current APR, we are planning to add an ENVS B.A. degree to match the B.A. in the EPS degree program.

The late 1990s to mid 2000s represented a period of considerable stability in the Department with steady but consistent growth in its faculty, in part due to transfers of faculty members from other departments, reaching a peak of 23 tenure track faculty and 3 lecturers (including the Natural Sciences Program) in 2009, the highest number in its history. During this period, the Department was also extremely successful at further enhancing its analytical infrastructure, adding several new pieces of sophisticated analytical equipment to our Department laboratories. These developments, along with a very research active faculty, increased the Department's research funding and research productivity as well as its central role in the University's educational and research mission. Since about 2010, the Department has continued to hire new faculty members; however, the total number of faculty and lecturers has declined as retirements have outpaced new hires and the Natural Sciences Program was closed in 2015. Since 2013, we have experienced a net loss of 3 faculty positions. Our recent hires have strongly emphasized geophysics (seismology and geodesy), paleobiology and petrology/ mineralogy.

1C: Organizational Structure *A brief description of the organizational structure and governance of the unit, including a diagram of the organizational structure.*

The Department of Earth and Planetary Sciences has a democratic style of governance that attempts to involve all faculty in key decision-making processes. A Department chair appoints two Associate Chairs to assist with the management of the Department and assumes responsibility when the chair is absent from the Department for any extended period of time. Current associate chairs are also chairs of large standing committees – Brandon Schmandt is Chair of the Graduate Committee and Gary Weissmann is Chair of the Undergraduate Committee. The Department chair has typically been appointed for a four-year term by the Dean based on a majority vote of Department tenure-track faculty. However, the previous three chairs have served shorter terms (John Geissman - 3.5 years; Adrian Brearley - 3 years (one as interim), Laura Crossey - 3 years). The current chair, Professor Peter Fawcett, has served one full term of 4 years and was just reappointed (at his request) for a second term of 2 years rather than 4.

The critical functions of the Department are overseen by standing committees that act in an advisory capacity to the chair. Recommendations from these committees on Department policies are brought by the chair to the full faculty for consideration and discussion, in some cases ultimately leading to a full faculty vote. Members of these committees are selected by the Department Chair following consultation with the faculty and following a fair workload balance. The most active and time-intensive departmental committees with significant workloads are the Undergraduate and Graduate Committees, the Graduate Admissions Committee, and the Strategic Planning Committee. Additional committees which play an important, but less active

role for specific issues, are the Faculty Productivity Assessment Committee, Facilities Committee, and the Computer Committee. We recently added a new committee on Diversity, Equity and Inclusion that includes faculty and a graduate student representative.

Annual performance evaluations for faculty are undertaken by the Department Productivity Assessment Committee, consisting of the department chair, one associate chair and three additional faculty members. The Department has an established productivity policy that is used to allocate salary increases in years when monies are available, although with the recent faculty unionization at UNM, salary increases will be governed by the Collective Bargaining agreement. The productivity policy is linked to our post tenure review policy.

Matters of key departmental concern, including faculty hiring, are considered by the faculty as a whole in faculty meetings. Recommendations brought by committee chairs to the chair are presented to the faculty in these meetings for discussion and a vote if required. Departmental policies are established by majority vote and may be subject to periodic revision as necessary. Traditionally, the Department had a one-hour faculty meeting every Wednesday at noon. The past two chairs, (Brearley and Crossey) broke from this tradition and called faculty meetings as needed and more into line with the frequency of faculty meetings held by other departments. This timeframe, with meetings typically held every two weeks has continued.

For faculty hiring, as required by UNM HR policies, faculty search committees make recommendations to the whole faculty, but then the faculty as a whole determines whom to invite for an interview and whom to hire. While the UNM Faculty Handbook allows emeritus faculty and lecturers to vote on hiring issues, our department practice has been that only tenure track faculty and our Principal Lecturer vote. For mid-probationary reviews, as well as tenure decisions, only tenured faculty participate and make recommendations to the chair.

The Department employs four administrative staff members and typically one or two work-study students. Staff duties and assignments are described elsewhere in this report. Due to earlier budget rescissions, we have not had a dedicated building manager for several years. The Department has several other technical staff members who have responsibilities relating to managing and supporting the extensive laboratory facilities that the Department maintains. These individuals are supported by a variety of funding sources, including I&G funding from the College of Arts and Sciences, departmental F&A funds, and revenues generated from operation of the laboratories as well as grants and contracts.

The Department shares faculty and resources including instrumentation with several UNM Centers. Two of these centers are directed by EPS faculty and the third has an EPS faculty member as an associate director. They include the Institute of Meteoritics (IOM; Director, Dr. Carl Agee), the Center for Stable Isotopes (CSI; Director, Dr. Zach Sharp), and the Center for Microengineered Materials (CMEM; Associate Director, Dr. Adrian Brearley; Director is Dr. Fernado Garzon). IOM and CSI are Category II Centers which report directly to the Associate Dean of Research in the College of Arts and Sciences and CMEM is a Category III Center which reports to the Vice President for Research.

The Center for Stable Isotopes grew out of the departmental stable isotope facility directed by Dr. Zach Sharp, and now incorporates faculty, postdocs, graduate students and undergraduate students from 9 departments at UNM. The primary stakeholders of CSI include EPS and Department of Biology personnel with significant involvement from IOM and the Department of Anthropology personnel. CSI facilities are mainly in the new PAIS building, however, it still maintains a laboratory footprint on the third floor of Northrop Hall and faculty and graduate student offices in Northrop.

The Institute of Meteoritics (IOM) has a long and distinguished history at the University of New Mexico. Founded in 1944, the IOM was one of the first institutions in the world devoted to the study of meteorites, and has over the past seventy-seven years earned a reputation as a premier center for research on planetary materials, featuring a unique collection of over 900 meteorites, most of which are extremely rare, including samples from Mars, the Moon, and many unusual asteroids. IOM shares space in Northrop Hall with EPS and two EPS faculty members have joint appointments with IOM (Dr. Carl Agee and Dr. Jin Zhang). Several IOM research scientists also have Research Professor appointments in EPS and graduate students working with IOM faculty have EPS as their degree granting department. There is significant sharing of facilities between EPS and IOM; however, IOM has a separate budget and its contract and grant expenditures are independent from the department (Dr. Jin Zhang's grants who has a joint appointment).

The Center for Micro-Engineered Materials (CMEM) is a university-wide collaboration bringing world class capabilities in micro and nano science and engineering. The Center focus is on "bottom up" additive approaches towards building materials and devices for energy conversion and efficiency, nanomedicine, earth & planetary sciences and environmental geochemistry. CMEM maintains campus wide high value characterization tools available for the use of the entire UNM research community, including the new Nanoscience Characterization Facility featuring new, state-of-the-art instrumentation. The Center has facilities in several UNM buildings, including the new PAIS building where shared EPS/CMEM instrumentation is housed. EPS faculty using CMEM facilities have their contract and grant expenditures listed within the department, as do those working with CSI.

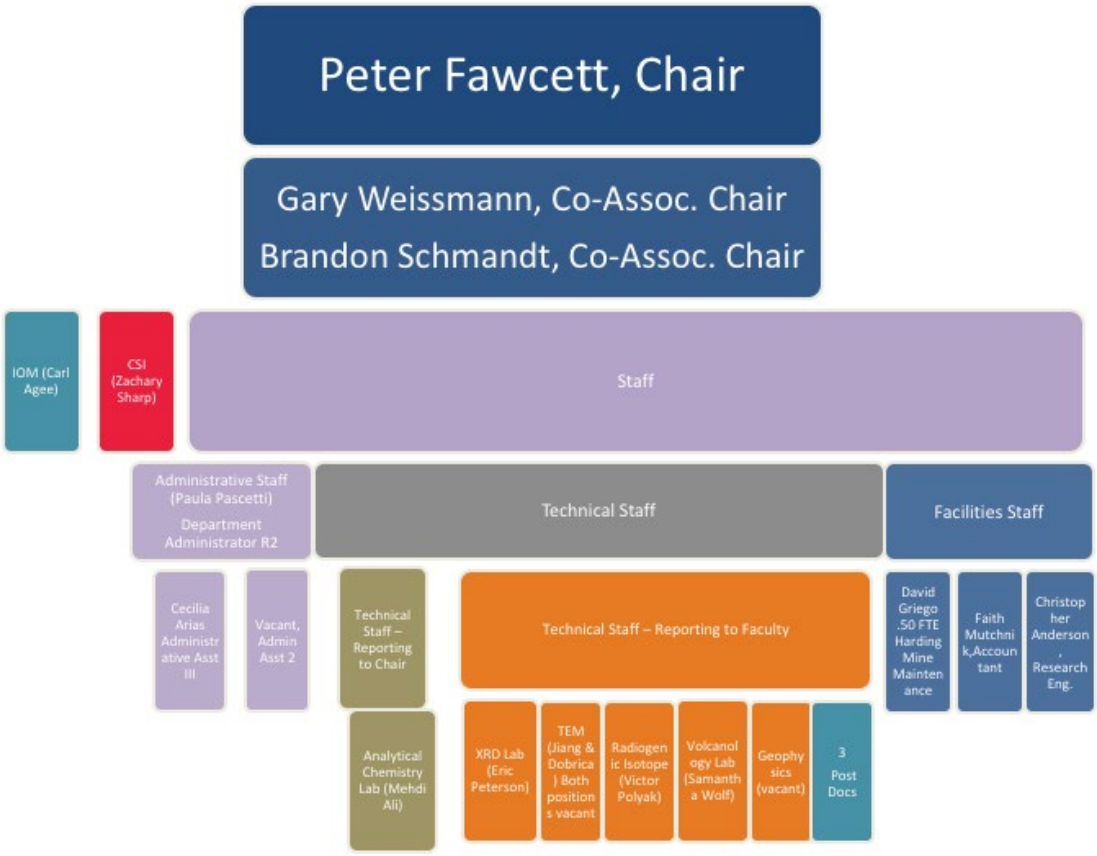

Figure 1 Organizational chart for the Department of Earth & Planetary Sciences and related centers.

1D: Accreditation *Information regarding specialized/external program accreditation(s) associated with the unit, including a summary of findings from the last review, if applicable. If not applicable, indicate that the unit does not have any specialized/external program accreditation(s).*

There is no accrediting body for Earth and Planetary Sciences. The Department undergoes review as part of the general UNM Academic Program Review process, which in turn informs the accreditation of UNM as a whole by the Higher Learning Commission of the North Central Association of Colleges and Schools.

1E: Previous APR *A brief description of the previous Academic Program Review Process for the unit. The description should:*

- *note when the last review was conducted;*
- *provide a summary of the findings from the Review Team Report;*
- *indicate how the Unit Response Report and Initial Action Plan addressed the findings; and*
- *provide a summary of actions taken in response to the previous APR.*

The last Academic Program Review was conducted in the fall of 2013 with the review team visiting from November 18-20. The review team consisted of Dr. William Carlson, University of

Texas, Austin, Dr. Thure Cerling, University of Utah, and Dr. Eric (Sam) Loker, UNM Department of Biology.

Summary of findings from the Review Team Report:
The review team identified several departmental strengths, including an outstanding faculty (recognized nationally and internationally), excellent scientific staff support, a close relationship with the Institute of Meteoritics, an impressive analytical capability, a culture for individualized learning (for both graduate and undergraduate students), special attention paid to the needs of minority students, outstanding faculty teaching introductory courses, a proud tradition of excellence in field-oriented courses, important new educational programs created with minimal resources, and that EPS graduates have an impact in the field. The review team also listed several shortcomings (seen as opportunities) including unmet student demand for undergraduate teaching, the summer field course needing a reliable funding structure, inadequate staffing for the Natural Science Education program, potential vulnerability of research staff, student navigation through the UNM system (advising at the undergraduate level, a perceived lack of consistency in application of graduate program requirements), departmental demographics (retirements), aging infrastructure, effective strategic planning, development effort, faculty salary stagnation, and a shrinking departmental budget.

Following the review team report, the department prepared an initial response to the APR followed by the development of an Action Plan in concert with UNM administration to address the challenges raised by the review team.

The major recommendations of the APR in 2013 were as follows:

1. EPS should work with A&S Dean's office to establish a mechanism that ensures secure, reliable, and predictable funding of the capstone summer field course.

2. EPS, in coordination with A&S, should strive to improve academic counseling of undergraduates, particularly for ENVS majors.

3. EPS should implement mechanisms to ensure consistency in administration of qualifying exams for the PhD and MS degrees, and to ensure adequate communication of expectations to all faculty.

4. EPS should articulate to higher administration the vital importance to its success of the contributions by its research staff.

5. EPS should implement an effective, inclusive, and visionary means of strategic planning, addressing not only short-term goals but also long-term issues including the unfavorable demographic make-up of its faculty and its aging infrastructure.

6. EPS, in partnership with the A&S Dean's Office and the UNM Foundation, should initiate a sustainable and effective alumni relations / development operation.

7. EPS should initiate a sustainable program aimed at identifying and expanding employment options for its graduates.

8. EPS should partner with all other relevant stakeholders in the University to resolve the status of the Natural Science education program in a way that ensures its continued success.

9. EPS, in partnership with the A&S Dean's office and/or the Graduate Office, should identify means to rapidly increase the TA support available, in terms of both numbers and levels of support.

10. EPS should work with the higher administration to continue to address salary inequities within the faculty ranks, exploring options beyond the remedies so far employed; and to whatever extent possible, action should be taken to render salaries in EPS competitive with those in competing departments in its peer institutions.

11. EPS should coordinate with the higher administration to ensure that a well-justified, carefully constructed strategic plan will eventually lead to infrastructural improvements that will ensure the long-term excellence of EPS's extraordinary laboratory facilities.

Following the last APR team's visit and recommendations, the department prepared a response to the APR and set about addressing each of these with the College Dean and Provost's office. The summer funding for our capstone field class was secured in 2014 and has been stable since then. The department made office space available for College undergraduate academic advisors (first Brian Vineyard; currently Maggie Summruld), and advising for our EPS and ENVS majors has improved remarkably. We continue to face pressure from our faculty and research staff demographics – retirements have recently outpaced new hires, but we have made incredibly successful recent hires who collectively represent a bright future for the department. Recent losses in technical support in critical labs like the TEM facility jeopardize the success of these facilities. As of the writing of this self-study in January 2021, Dean Mark Peceny has provided bridge funding to move forward with one of those critical positions; however, we are concerned with the long-term stability in our essential technical help. Dean Peceny and former Chair Laura Crossey were also instrumental in meeting several of the other concerns raised by the Department and the Review Team, including providing a salary boost to many mid-level and senior faculty in 2014, as well as effectively advocating for an additional set of TA lines. Since the last APR, we have become even more successful in alumni outreach with a series of alumni events (Fall Homecomings, LoboLiving Room, Graduation, etc.) and have seen a significant increase in alumni support for all aspects of our program (undergraduate and graduate scholarships, the field program, endowed lecture series and some significant unrestricted funds). The department has held a number of retreats over the last 10 years (in addition to regular faculty meetings) to work on curriculum revision, new directions and new hires, and improving our graduate program. The only recommendation that could not be followed was for the Natural Sciences Program, which was closed in 2016.

1F: Vision & Mission *Provide a brief overview of the vision and mission of the unit and how each degree/certificate offered addresses this vision and mission. Describe the relationship of the unit's vision and mission to UNM's vision and mission. In other words, to assist the*

university in better showcasing your unit, please explain the importance of its contribution to the wellbeing of the university, including the impact of the unit's degree/certificate program(s) on relevant disciplines/fields, locally, regionally, nationally, and/or internationally?

As part of the flagship research university in the state of New Mexico, the main missions of the Department of Earth and Planetary Sciences are to conduct research and other scholarly activities contributing to human knowledge and awareness of the natural environment, and to provide a high-quality learning environment for students at the Undergraduate, Master's and Doctoral levels in the Earth and Planetary Sciences and Environmental Sciences. Research and teaching are regarded as being of equal importance; indeed, each complements and enhances the other.

Each faculty member is expected to establish and maintain an active and high-quality research program with national and international visibility that involves undergraduate and graduate students in their research activities. Also, faculty are expected to disseminate the results of the research to the academic and professional earth, environmental, climatologic and planetary sciences community through publications, presentations at professional meetings and symposia, and to participate in other scholarly activities, such as service in professional organizations and on state, national and international panels and committees. The research activities of some faculty members involve extensive use of the numerous analytical facilities in the Department. An important part of our research mission is to enhance the University's analytical laboratory infrastructure and to make departmental facilities available to researchers and students across the campus, as well as to national and international researchers and students as part of a University-wide array of analytical laboratories that serves as a focus for inter- and multidisciplinary studies. To serve this goal, several faculty members in the Department direct and manage significant multiuser analytical laboratories and oversee the development of these facilities to serve the needs of the campus community. Since the last APR, we have significantly expanded our facilities footprint with the new PAIS building that houses the Center for Stable Isotopes (CSI), the Nanomaterials Characterization Facility (TEM), and XRD lab. The former Biology Annex is currently being renovated to create a Natural History Science Center in collaboration with the Museum of Southwest Biology and the Honors College. The NHSC will be devoted to research, educational outreach and curation of vertebrate and invertebrate fossils.

In its educational programs, the faculty maintains a strong commitment to high-quality teaching. A broad range of undergraduate geology and environmental science courses are offered to prepare students for careers as professional earth and environmental scientists for graduate school, or as Earth Science teachers in public schools; and to educate non-geology majors in the basic principles and applications of the earth, planetary and environmental sciences. A major responsibility of the faculty is to mentor and train graduate students at the Masters and Ph.D. levels in advanced topics covered in course work and in the process and practice of carrying out independent research for careers in industry, government, and academia. The Department's graduate students primarily participate in research; however, nearly all graduate students are engaged in teaching at some period during their time at UNM, as will be described in more detail in subsequent sections. Graduate students are also engaged in public service, including their participation in Departmental Museum tours, Homecoming and UNM Welcome Back Days, STEM days at the NM State Fair, volunteer teaching at local public schools, and other engagements with K-12 teaching as well as outreach with public lands.

The Department feels a special responsibility to the larger world outside of the University. The Earth and Planetary Sciences play a central role in New Mexico because a substantial fraction of the state's yearly revenue is derived from taxes on the extraction of its geological resources. In addition, a large part of the state's limited supply of water comes from a combination of subsurface aquifers and runoff from our montane watersheds - all areas of study by our faculty and students. Earth and Planetary Sciences faculty regularly serve on advisory panels or as consultants to numerous city, state, federal and private agencies involved in such subjects as radioactive waste disposal, land use and environmental impacts, water supply and climate/weather in New Mexico as well as the global climatic environment addressed by the IPCC. The Department's two museums educate thousands of members of the public annually, including many school classes.

The Department has also helped to support other organizations in the College of Arts and Sciences whose activities clearly support the general goals of the Department. The Center for the Southwest, the Institute for Medieval Studies (IMS), and the Institute of Social Research (ISR), and the Museum Studies Program enhance the scientific education of the University community as well as the general public, albeit in ways that differ substantially than those used by the Department. The IMS, for example, sponsors symposia that address the evolution of scientific thought and the roots of scientific disciplines during the Middle Ages. The UNM Museum Studies programs provides an undergraduate certificate and offers graduate degrees in Museum Studies (MA / MS in MSST). EPS museums and faculty play a role in these programs. EPS faculty, staff and facilities contribute strongly to UNM Engineering programs in the Materials Science and Hydrologic Science areas. EPS faculty also play a role in UNM's Master of Water Resources (MWR) program (an interdisciplinary program housed in Graduate Studies) through teaching and mentoring MWR students, offering courses relevant to the program and playing leadership roles on the Advisory Board. In these and many other ways, the faculty and research staff of the Department of Earth and Planetary Sciences provides the people of New Mexico with a pool of professional expertise that serves in the development of the state's resources, preservation and wise use of its environment, and a better awareness of the world they live in.

The most recent University mission and vision statements are provided in the UNM2020 Strategic Plan Refresh published on the UNM website (http://strategy.unm.edu/). This document states that "The University will engage students, faculty, and staff in its comprehensive educational, research, and service programs. UNM will provide students the values, habits of mind, knowledge, and skills that they need to be enlightened citizens, to contribute to the state and national economies, and to lead satisfying lives." Faculty, staff, and students create, apply, and disseminate new knowledge and creative works; they provide services that enhance New Mexicans' quality of life and promote economic development; and they advance our understanding of the world, its peoples, and cultures. Building on its educational, research, and creative resources, the University provides services directly to the City and State, including health care, social services, policy studies, commercialization of inventions, and cultural events.

The most recent UNM Vision Statement holds that "UNM will build on its strategic resources:

- to offer New Mexicans access to a comprehensive array of high quality educational, research, and service programs,
- to serve as a significant knowledge resource for New Mexico, the nation, and the world; and
- to foster programs of international prominence that will place UNM among America's most distinguished public research universities."

There are multiple elements to the University's stated vision that the Department of Earth and Planetary Sciences engages in and promotes as part of its essential functions. These include: student success through collaboration; strength through diversity; vital academic climate; excellence through relevance; research for a better world; health and wellness; leadership; and international engagement.

The Department of Earth and Planetary Sciences actively promotes all applicable elements of the mission and vision statements. The high research productivity of the faculty (discussed under Criterion 5) is appropriate to a flagship university, as are our nationally competitive doctoral and master's programs. We provide high-quality instruction, upholding high standards for student achievement. Both our undergraduate and graduate programs offer opportunities for student collaboration in research, as well as involvement in public service through internship programs. Faculty frequently co-author peer-reviewed articles with graduate students. The Department maintains a vital academic climate through a politically and ideologically open climate in classrooms, through organized group discussions of works in progress and other opportunities for faculty and students to present their research, and through a minimally hierarchical organizational culture in which graduate students are treated as colleagues and are free to challenge faculty members' ideas.

Our faculty carry out research in multiple areas of the geosciences of critical importance to society, such as global climate change and its effects on hydrology and ecosystems, water quality and distribution in the southwest. Other areas of research in the Department that are of significant interest to the general public and aid the general public's understanding of science are the evolution and origin of the Grand Canyon, volcano and earthquake activity driven by plate tectonics, and the evolution of our solar system as documented by analysis of meteorites and samples from space missions. Many department faculty are involved in international scholarly collaborations, conduct research abroad, and maintain strong connections to international scholarly initiatives.

A Note on how EPS Responded to the COVID-19 Pandemic and some Observations for the Future

Following the outbreak of COVID-19 in the United States, the University of New Mexico abruptly switched to fully online learning as of March 23, 2020 following the week-long spring break. With little prior planning, faculty, staff, and graduate students in the department worked tirelessly to move their classes online while dealing with child care issues, family health issues, and great uncertainty in how long this would go on and how severe the pandemic would be. Some classes started right away, and some took an extra week or two to begin instruction again. Overall, this switch to remote learning worked well, albeit with less material covered and critical

lab components scaled back considerably. Our summer capstone field class (EPS 319) was moved to a virtual format, taking advantage of our faculty expertise in GIS, and collaborative development of remote curriculum ideas with other virtual field camps. Over the summer, many faculty and TAs took advantage of the Center for Teaching and Learning classes on best practices in remote instruction and worked hard to move classes online for the fall 2020 semester. Some classes in the fall were able to meet in person in a limited fashion, primarily for socially distanced field trips, but with some in person lab component as well. As we begin a new year and semester in spring 2021, we continue to deliver most of our curriculum in a remote fashion. Research in our laboratory facilities and field work also continues in person in a much more restrained fashion, with strict limits on the number of students and faculty allowed in labs. As a result, research productivity and expenditures have likely decreased relative to recent years, although faculty and graduate students continue to publish high-quality research and continue to submit competitive grants to funding agencies including NSF and NASA.

The sudden switch to online learning in March 2020 and continuing remote instruction for two additional semesters in this mode have come at a cost. We have always known that there is great inequality in our students' background and preparation, and with remote learning, this was greatly exacerbated. The most obvious differences were in terms of student access to broadband and Wi-Fi, and computer ownership. There were also significant challenges faced in terms of childcare, time to spend on academics vs. jobs / family responsibilities, and of some unfortunately fell ill with the virus. The effect of long-term isolation on both undergraduate and graduate students (not to mention faculty) has undoubtedly impacted morale, and our new cohort of graduate students began in fall 2020 without meeting each other or our other graduate students in person (as is true of programs across the country). We were able to make use of our very generous alumni donations and provided emergency scholarships in April 2020 of $500 for undergraduate majors and $250 for pre-majors. We also accelerated a plan to fund our graduate students for one month in the summer using alumni scholarships and unrestricted donations. Students with insufficient or no computer resources were allowed to check out laptops purchased by the Natural Sciences Program for the more computationally demanding classes.

As noted in the December 12, 2020 issue of *The Economist* magazine, the pandemic has accelerated existing trends of technological adaptation in a variety of areas, but especially so in education. That is particularly true for this department, which previously had very limited online class offerings. The sudden shift to this mode has been painful, but there have been some positives with online learning (for example, the share screen mode in Zoom has allowed TAs and faculty to better diagnose issues with computer-based labs, GIS, statistics and data analysis etc.) Increased use and acceptance of Zoom and Google Meet allowed many faculty to start or further develop research collaborations with US and international colleagues. Our weekly lecture series shifted to Zoom and has worked extremely well in some ways; we were able to bring in speakers from many places or whose schedule limited their travel, and this has reduced costs (travel, hotel, food), but we miss the camaraderie of meeting every Friday at 3:00 PM. We also miss the opportunity to meet with speakers one on one as was done in the past. We are unsure what will remain of this remote experience post-pandemic. Faculty and students are keen to return to in-person learning, especially for field trips and lab experiences that cannot be adequately done in a remote format. However, having shorter recorded lectures available online with class time devoted to in-person activities or lab activities could make all of us more effective and engaged

teachers. Going forward, the department will want to consider a hybrid future for our educational activities that mixes remote and in-person learning as a way of maximizing our strengths, particularly with declining resources.

The pandemic has been described in some places as a "black swan event", but in fact, it is no such thing. A true black swan event is an *unpredictable*, rare, catastrophic event. But the COVID-19 pandemic was entirely predictable as a low-probability, high impact event (sometimes called a Gray Rhino – an obvious but often neglected threat - and the same is true for growing antibiotic resistance spreading globally). The fact that our society was largely unprepared for this, despite what should have been adequate warning, has focused attention on the coming decades certain and even higher-impact disaster – anthropogenically-driven climate change. The Department of Earth & Planetary Sciences is uniquely positioned to help address this issue with a wide range of faculty and graduate student expertise in climate change and related issues (e.g., water resources) and well-established collaborations with neighboring UNM departments like Biology, Anthropology, Civil Engineering, the UNM Grand Challenge in Sustainable Water Resources, etc. However, our departmental demographics and likely future retirements endanger this position, most recently with the retirement of climatologist David Gutzler. We have also recently lost two surface processes faculty to retirements who studied the effects of climate change on NM and Southwest landscapes. As a result, the department has as its highest priority for new hires in the areas of surface processes and hydroclimatology, and we see a strong role for ourselves in this critical societal issue that will only become more important in the coming years.

One other note from the pandemic – the job losses that occurred in the United States and other parts of the world were concentrated among the less skilled. Our undergraduate degrees in Earth and Planetary Sciences and in Environmental Sciences provide essential skills and training for a variety of careers in the Earth and Environmental Sciences and prepare our students well for job opportunities in the coming decades.

Criterion 2. Teaching & Learning: Curriculum

The unit should demonstrate the relevance and impact of the curriculum associated with each degree/certificate program. (Differentiate for each undergraduate and graduate degree and certificate program offered by the unit.)

2A: Curricula *Provide a detailed description of the curricula for each degree/certificate program within the unit.*

- *Include a description of the general education component required, including any contributions from the unit to general education, and program-specific components for both the undergraduate and graduate programs.*
- *Discuss the unit's contributions to and/or collaboration with other internal units within UNM, such as common courses, courses that fulfill pre-requisites of other programs, courses that are electives in other programs, cross-listed courses, etc.*

The Department offers three undergraduate degrees (BS, Environmental Science; BA, Earth & Planetary Science; and BS, Earth & Planetary Science), Departmental Honors, and two graduate degrees (MS, Earth & Planetary Sciences; PhD, Earth & Planetary Sciences). Since the last

APR, the University closed the BS in Natural Science, a program focused on K-12 pre-service teaching in Earth Science. We also administer minors in Environmental Science and in Earth & Planetary Science. This section describes the curricula for each of these programs, but additional information is available on the Department website (https://eps.unm.edu/index.html).

BS, Environmental Science (ENVS)

The BS in Environmental Science offers an Earth-Systems-based curriculum that prepares students to continue to graduate school or begin careers related to Environmental Science. This major was completely revised over the past five years, and we are currently graduating our first cohort under the redesigned major. The curriculum was designed to begin with an emphasis on systems thinking and analysis in the Environmental Systems course (ENVS 320L) and end in a capstone delivery that focuses on project-based learning in Advanced Environmental Science (ENVS 430L). Throughout this curriculum, course activities are linked between courses in the succession, with several exercises built on a foundation from previous classes. An emphasis on geospatial analysis of environmental data, though linked exercises using ArcGIS and other software, not only provides students with tools to evaluate large datasets in Environmental Science, but it also prepares our students for successful careers in the field.

The systems thinking and analysis, along with other aspects of the curriculum (e.g., building a curriculum that develops a cohort of students; encouraging group work; integrated approaches to learning); Curriculum-based Research Experiences, e.g., CUREs), were developed with concepts of Multicontext Theory in mind (e.g., Ibarra 2001; Weissmann et al., 2019). These concepts are thought to enhance diversity and inclusion in the program. Additionally, several courses apply Multicontext Theory concepts to enhance activities to build an inclusive environment. The goal in applying these concepts is to help all students in the ENVS degree program thrive.

Details of the curriculum, including Programmatic and Student Learning Outcomes and where these outcomes are addressed in each required course, are included in the curriculum matrix in Appendix 1. Courses included in the ENVS major include the following:

Table 1. Required Courses for the ENVS Major

Course Number	Course Title	Prerequisites	Time offered
ENVS 1130/1130L*	The Blue Planet	None	Fall, Spring, Summer
ENVS 315	Statistics in Earth Sciences	MATH 1512	Spring
ENVS 320L	Environmental Systems	ENVS 1130/1130L	Fall, Spring
ENVS 321L	Earth Materials	ENVS 1130/1130L; CHEM 1215/1215L; MATH 1240 or 1250	Spring
ENVS 322L	Life in the Earth System	ENVS 1130/1130L; BIOL 1140/1140L; MATH 1240 or 1250	Fall
ENVS 323L (soon to be ENVS 423L)	Water in the Earth System	ENVS 320L; MATH 1512;	Fall

		PHYC 1310; CS151L; ENVS 315	
ENVS 324 (soon to be ENVS 424)	Earth's Climatic System	ENVS 323L; MATH 1522	Spring
ENVS 430L	Advanced Environmental Science	ENVS 323L; co-req: ENVS 324.	Spring
EPS 401	Colloquium	Co: EPS 490	Fall, Spring
EPS 490	Geologic Presentations	Co: EPS 401	Fall, Spring

*Students may also enter the major with GEOL 1110/1110L (Physical Geology) instead of The Blue Planet.

Additionally, students are required to take 12 additional credits in EPS courses, 4-credits may be 200-level.

Supporting Science Requirements:

- CHEM 1215/1215L: General Chemistry I for STEM Majors
- CHEM 1225/1225L: General Chemistry II for STEM Majors
- MATH 1512: Calculus I
- MATH 1522: Calculus II
- PHYC 1310: Calculus-based Physics I
- PHYC 1320: Calculus-based Physics II
- CS 151l: CS4All
- BIOL 1140/1140L: Biology for Health Science and Non-Majors
- ENGL 2120 or 2210: Intermediate Composition or Technical and Professional Communication
- Additional 3 credit hours from Chemistry, Physics, Math, Biology, Astronomy, Geography, or Engineering

In the near future, we are planning to design a BA in ENVS that will not require as much Math or Physics. These courses, external to our Department, tend to be barriers for many of our students' success. By developing a BA that does not require the Calculus background, we can offer an ENVS degree that will allow students to graduate in a timely manner.

BS, Earth & Planetary Science (EPS)

The BS in Earth & Planetary Science offers a comprehensive curriculum in Geoscience. We are planning to revise this curriculum in the near future to emphasize systems science and enhance skill development related to modern technology. Potential directions for revision were identified in a 2018 faculty retreat and now more detailed design can proceed with input from a larger cohort of junior faculty. The BS in EPS curriculum is designed to provide students with a foundation in Earth processes to prepare them for careers in geoscience.

Courses included in the BS in EPS major include the following:

Table 2. Courses Required for the EPS BS Major

Course Number	Course Title	Prerequisites	Time offered
GEOL 1110/ 1110L*	Physical Geology		Fall, Spring, Summer
GEOL 2110C	Historical Geology	GEOL 1110/1110L	Fall, Spring
EPS 301/302L	Mineralogy/Earth & Planetary Materials Lab	CHEM 1215	Fall
EPS 303L	Igneous and Metamorphic Petrology	EPS 301/302L; PHYC 1310	Spring
EPS 304L	Sedimentology and Stratigraphy	EPS 303L	Fall
EPS 307L	Structural Geology	EPS 304L	Spring
EPS 319L	Field Geology	EPS 307L	Summer
EPS 401	Colloquium	Co: EPS 490	Fall, Spring
EPS 490	Geologic Presentations	Co: EPS 401	Fall, Spring

*Students may also enter the major with ENVS 1130/1130L (The Blue Planet) instead of Physical Geology.

Additionally, students are required to take 12 additional credits in EPS courses.

Supporting Science Requirements:

- CHEM 1215/1215L: General Chemistry I for STEM Majors
- CHEM 1225/1225L: General Chemistry II for STEM Majors
- MATH 1512: Calculus I
- MATH 1522: Calculus II
- PHYC 1310: Calculus-based Physics I
- PHYC 1320: Calculus-based Physics II
- ENVS 315 or STAT 345: Statistics in Earth Science or Elements of Mathematical Statistics and Probability Theory.
- ENGL 2120 or 2210: Intermediate Composition or Technical and Professional Communication
- Additional 7 credit hours from Chemistry, Physics, Math, Biology, Astronomy, Geography, or Engineering

BA, Earth & Planetary Science (EPS)

The BA in Earth & Planetary Science offers a comprehensive curriculum in Geoscience but requires less math and field geology, and electives requirements. We are planning to revise this curriculum in the near future along with the BS in EPS. The BA in EPS curriculum is designed to provide students with a foundation in Earth processes to prepare them for careers in geoscience, however it is not typically rigorous enough to provide a stepping stone into graduate school without future coursework.

Courses included in the BA in EPS major include the following:

Table 3. Courses Required for the EPS BA Major

Course Number	Course Title	Prerequisites	Time offered
GEOL 1110/ 1110L*	Physical Geology		Fall, Spring, Summer
GEOL 2110C	Historical Geology	GEOL 1110/1110L	Fall, Spring
EPS 301/302L	Mineralogy/Earth & Planetary Materials Lab	CHEM 1215	Fall
EPS 303L	Igneous and Metamorphic Petrology	EPS 301/302L; PHYC 1310	Spring
EPS 304L	Sedimentology and Stratigraphy	EPS 303L	Fall
EPS 307L	Structural Geology	EPS 304L	Spring
EPS 310L or EPS 319L	New Mexico Field Geology or Field Geology	GEOL 1110/1110L	Fall
EPS 401	Colloquium	Co: EPS 490	Fall, Spring
EPS 490	Geologic Presentations	Co: EPS 401	Fall, Spring

*Students may also enter the major with ENVS 1130/1130L (The Blue Planet) instead of Physical Geology.

Additionally, students are required to take 6 additional credits in EPS courses.

Supporting Science Requirements:

- CHEM 1215/1215L: General Chemistry I for STEM Majors
- PHYC 1230 or 1310: Physics I
- Additional 9 credit hours from Chemistry, Physics, Math, Biology, Astronomy, Geography, or Engineering

EPS/ENVS Honors:

As part of a diversified, rigorous and thorough program of undergraduate study in the Geosciences or Environmental Science at UNM, the Department of Earth & Planetary Sciences offers a Departmental Honors option. The program is available to both EPS (BS & BA tracks) and ENVS majors and requires independent research in collaboration with a faculty member. This option is strongly recommended for students who intend to pursue graduate studies. The purpose of this program is to introduce undergraduates to independent research, its methods, data analysis and written preparation.

Students completing Departmental Honors are able required to complete two courses – Independent Study (EPS 493) and Senior Thesis (EPS 495). Through these courses, students work with a faculty mentor to complete an independent research project. This culminates in completion of a senior thesis, which is orally defended in an open forum in the Department.

A listing of Honors degree recipients from 2013-2020 is provided in Appendix 2. About 25-30% of our undergraduate majors participate in undergraduate research and complete departmental honors.

Master of Science in Earth & Planetary Sciences

The Department offers an M.S. program in Earth & Planetary Sciences, and we have only a thesis option for this degree with a strong research emphasis. The degree requirements include 24 hours of coursework at the 400- or 500-level in Earth and Planetary Sciences with an average grade of 3.0 or above plus a minimum of 6 hours of EPS 599 (M.S. Thesis) for a total of 30 credit hours. It is a Departmental policy that 300-level EPS courses do not carry graduate credit, but 300-level classes in other departments do. The following course distribution is required:

a) A minimum of 6 hours of 500-level courses
b) A maximum of 3 hours of Problems level courses can be taken for credit (although students may enroll for more hours)
c) Not more than half the minimum course hours may be taken with any one professor.

M.S students are required to take a comprehensive exam in their second semester in residence to evaluate their understanding of the chosen thesis topic. This exam includes a written proposal of no more than 15 pages, a 20-30-minute presentation to the thesis committee, and a follow-up period of questions on the proposal and presentation by the committee. Following successful completion of the comprehensive exam, M.S. students must submit the University's Office of Graduate Studies Program of Studies form for the master's degree.

Thesis progress and defense: Each student is encouraged to meet with their thesis committee on an annual basis, and writes a short progress report and updated CV each April that is submitted to the Departmental Graduate Committee. Once the thesis work is completed, the thesis research is presented before an open meeting of the Department and other interested individuals. Following the presentation (typically 30-40 minutes), any member of the audience is invited to ask questions. This is followed by a closed session with the thesis committee who ask any questions pertaining to the thesis and supporting material. Once the defense is passed, the student must submit copies of the final accepted thesis to the Office of Graduate Studies within 90 days.

Doctor of Philosophy in Earth & Planetary Sciences

The Department offers a Ph.D. program in Earth & Planetary Sciences, and we have only a thesis option for this degree with a strong research emphasis. A Ph.D. student must complete a minimum of 48 hours of coursework beyond the Bachelor's degree that carry graduate credit in geology and other subjects relevant to his or her specialty. A maximum of 30 hours of coursework completed for the Master's degree, including 6 hours of thesis credit, may be applied toward the 48-hour requirement. A minimum GPA of 3.0 (B average) must be maintained. The following requirements hold:

a. At least 18 hours of 500-courses,
b. At least one semester of enrollment in EPS 501 (colloquium),

c. No more than half the total graduate course hours counted toward the required total may be taken with any one professor,
d. A maximum of 3 hours of problems courses may be taken for credit,
e. No more than six hours of C grades may be included in the degree program,
f. At least 18 hours of dissertation credits (EPS 699).

A student who enters UNM in the M.S. program but who subsequently wishes to convert the M.S. project into a Ph.D. dissertation must inform his or her committee of this desire **prior** to taking the M.S. exam in the second semester. The committee will then use the oral examination as a tool to probe the student's readiness to advance directly into the Ph.D. program, and will make an appropriate recommendation to the full faculty. If the faculty endorses the recommendation, the student will then prepare a second proposal and defend it in the third semester in residence. This second oral examination must occur prior to the last 4 weeks of the 3rd semester.

Students who successfully transition from the M.S. to the Ph.D. program via the above procedure will receive a maximum departmental commitment of 4 years of funding: 1 year while M.S. candidate, and 3 additional years as Ph.D. candidate. If student fails the Ph.D. exam, he/she may revert back to the M.S. program.

Ph.D. Comprehensive Examination: PhD students are required to take a comprehensive exam in their third semester in residence to evaluate their understanding of the chosen thesis topic. This exam includes two written proposals on separate topics, advised by different faculty members. Extended abstracts for these proposals must be submitted to the faculty for approval during the second semester in residence. The research topics should be sufficiently different in scope as to warrant interaction with two different principal advisors with different research interests. One of the abstracts normally focuses on the student's proposed dissertation topic. During the third semester in residence, a Ph.D. student must submit and orally defend two research proposals developed from the extended abstracts. This includes a 30-minute presentation to the thesis committee and a follow-up period of questions on both proposals and presentations by the committee. Following successful completion of the comprehensive exam, Ph.D. students must submit the University's Office of Graduate Studies Program of Studies form for the Ph.D. degree.

Dissertation Requirements: Recognizing the fact that part or all of a dissertation will be published as a multi-authored contribution, the Department has established general guidelines to which students and their committees should adhere. Regardless of the number of authors, the student must have done the bulk (i.e. "51 percent or more") of the research and preparation for publication. The student has to be the first author on each publication submitted as part of a dissertation. The dissertation must include a preface in which the student briefly explains the role of each of the authors in any multi-authored section or chapter of the dissertation. Any manuscript submitted for outside publication should be distributed to all members of the committee. A copy of the dissertation must be provided to all members of the committee, and placed on file in the EPS main office, at least **two weeks** prior to the scheduled defense.

Oral Defense of Dissertation: An oral presentation dealing with the dissertation will be given by the student; this is open to the public. The Committee on Studies will then have a closed period for questioning the candidate. Dissertation defenses are typically scheduled during the academic year, excluding finals week. The candidate must notify the Main Office Personnel three weeks in advance of the date, time, committee and title to gain a room and appropriate approval forms. In all cases the results of the dissertation defense must be submitted to the Office of Graduate Studies no later than two weeks after the announced date of the dissertation defense. The final signed dissertation must be submitted to the Office of Graduate Studies within 90 days of the thesis defense. The doctoral dissertation must be completed within five years following the formal advancement to candidacy (i.e., the comprehensive exam requirements).

Department Contributions to the General Education Core curriculum

The Department offers five courses that contribute to the General Education mission of the University. These courses include:

- GEOL 1110 (3 credits); How the Earth Works
- GEOL 1110L (1 credit); Physical Geology Laboratory
- GEOL 2110C (4 credits): Historical Geology
- ENVS 1130 (3 credits); The Blue Planet
- ENVS 1130L (1 credit); The Blue Planet Laboratory

Since our last Programmatic Review, the University requirements have significantly changed so students are no longer required to take as many General Education science courses. This dramatically decreased enrollments in GEOL 1110 and ENVS 1130, with enrollments in these classes being approximately half of enrollments prior to this change.

Cross-listed courses in other departments:

Several courses offered in the Department are cross-listed with other units.

EPS course	**Cross-listed as:**
EPS 251 - Meteorology	Geography 251
EPS 352 - Global Climate Change	Geography 352
EPS 427 - Geophysics	Physics 327
EPS 462/562 - Hydrogeology	Civil Engineering 441/541
EPS 482L/582L - Geoarchaeology	Anthropology 482L/582L
EPS 535 - Freshwater Ecosystems	Biology 535
EPS 558 – Geomicrobiology	Biology 558
EPS 476/576 – Physical Hydrology	Water Resources 576

2B: Mode of Delivery *Discuss the unit's mode(s) of delivery for teaching courses.*

Courses in the Department of Earth and Planetary Sciences are taught using lecture, in-class activities, experiential learning in laboratories, and high-impact field experiences. We also offer two fully online courses (GEOL 1110 and ENVS 1130), though during the Coronavirus pandemic, most courses were shifted to an online/remote platform. Most of our courses at all levels use a web-enhanced design that include UNM's LEARN (e.g., Blackboard). Several

faculty use social media and classroom technologies such as clickers to promote learning. The faculty teach with varying degrees of active learning including two faculty members who teach in Learning Studios. Though the large lecture hall is not optimal for activities, some faculty members have developed active classrooms that take advantage of the large space.

Figure 2. ENVS 1130 students working on activities in Northrop Hall 122.ENVS 1130 students working on activities in Northrop Hall 122.

Learning studios are designed to enhance and enable collaborative learning that is student-centered rather than instructor-centered. This is obvious the moment that you walk into a learning studio as there is no "front" of the room. The room is filled with 9-seat, circular tables with 3 laptops on each table. Our faculty work from the middle of the room, lecturing sparingly, and with easy access to all students to increase engagement. Provided computers enable students to access online resources, use simulations and animations, and for paperless team-generated assignments to be completed and submitted for instructor assessment using UNM's Learn platform. Students can work in teams to address questions using whiteboards that surround the learning studio. While some of these functions can be accomplished to varying extents in traditionally furnished classrooms, research at other universities demonstrates much better collaboration and learning that are facilitated by the circular tables and provided technologies. Because learning studios are such an effective way of engaging our students, the EPS Department remodeled a combined classroom/laboratory space to contain many of the features of a learning studio (Northrop 116; to a lesser extent Northrop 105).

Criterion 3. Teaching & Learning: Assessment

The unit should demonstrate that it assesses student learning and uses assessment to make program improvements. In this section, the unit should reference and provide evidence of the program's assessment plan(s) and annual program assessment records/reports. (Differentiate for each undergraduate and graduate degree/certificate program and concentration offered by the unit.)

3A: Assessment Plans *Provide current Assessment Plan for each degree and certificate program in the unit.*

The Assessment Plans and Assessment reports for 2019-2020 academic year are in Appendix 3. This is a combined report that is used by the UNM office of Assessment. With recent revisions to the ENVS curriculum and more recent changes to the Student Learning Outcomes (SLOs) for the ENVS program, the Assessment Plans for this program are more advanced than the assessment plan for our other undergraduate degree programs (e.g., BA and BS in EPS). We are also in the process of developing interim assessments for internal Departmental use. Interim assessments are used to evaluate how a cohort of students are progressing toward reaching our SLOs by evaluating how they accomplish tasks related to the SLOs in 300-level classes in the core for the ENVS major. This will allow us to track student cohort progress through the program and catch areas that may need enhancement for success in meeting SLOs by our students, and it offers another place for the Department to continue improving the degree program. Once the ENVS assessment plan is completed, we will model the EPS (BS and BA) assessment plans after the ENVS plan.

3B: Assessment Reports *Provide current Assessment Report for each degree and certificate program in the unit. Expand on any initiatives/changes that have resulted from these reports.*

The Assessment Plans and Assessment reports for 2019-2020 academic year are in Appendix 3. This is a combined report that is used by the UNM office of Assessment.

As noted above, the ENVS assessment plan is more advanced than the plans for our other degree programs. In recent years, assessment was used to:

- Revise our SLOs so they are more readily assessable.
- Make changes in curriculum structure and course offering order to improve student graduation rates.
- Make changes in course activities to coordinate skills between classes needed for success at meeting SLOs by our students.
- Improve use of GIS software throughout many ENVS classes so our students are proficient at this skill (though the COVID pandemic slowed progress on some of this work).

Along with the assessable SLOs, the department also developed a set of skill objectives and these are tracked to be sure classes address these skills in several exercises (see the ENVS curriculum matrix in Appendix 1).

As we begin revision of the EPS degree programs to reflect geoscience in the 21st century, we will be able to develop areas where all current SLOs are assessed (we currently have no assessment strategy for 2 of our SLOs). Additionally, at this time, the primary difference between the BA and BS in EPS is the level of math required and the field geology requirement. Since most classes are mixed, we currently do not have a means to separately assess the BA students. The BS in EPS students are primarily evaluated in the Field Geology course (EPS 319L), however some SLOs are assessed in classes where BA and BS in EPS students are mixed. Future planning will require us to somehow build assessment plans that distinguish each program.

As noted in our recent Assessment Plans and Assessment Reports for 2019-2020 (Appendix 3), several of the SLOs benchmarks were not met. We plan to discuss these issues during a faculty meeting in the future, and we will develop a plan to help future student cohorts meet the SLO benchmarks. Additionally, some new shortcomings of students in our EPS majors were identified last year due to the need to go online for Covid, including lack of computer literacy for some software. As we revise the EPS degrees in the future, we will incorporate some of these skills into the curriculum.

The Covid pandemic has created additional challenges for completing assessment. Primary to this was that faculty members were doing all they could to deliver materials in courses used for assessment. This year, we believe we can complete assessments of students through evaluation of online artifacts developed by the students. In the 2019-2020 report, much of the assessment was conducted on students from Field Geology (the BS in EPS capstone course) from the online artifacts. We expect to be able to complete the remainder of SLO assessment in this manner in the 2020-2021 academic year.

Graduate degree assessments occur using a 3-year rotation among SLOs specific to the MS and PhD degrees. These assessments are primarily based on student development of scientific research design, implementation, and communication skills (Appendix 3).

3C: Primary Constituents *Describe the unit's primary constituents and stakeholders. Include and explanation of how the student learning outcomes for each degree/certificate are communicated to students, constituents, and other stakeholders.*

The primary constituents that the Department of Earth and Planetary Sciences serves are its undergraduate students who major in Earth and Planetary Sciences and Environmental Sciences and our M.S. and Ph.D. students. Important stakeholders are the future employers of our undergraduate and graduate students.

An additional important group of constituents for the Department are undergraduate students who use the department's 1000-level lecture, on-line and laboratory classes to fulfill UNM general education requirements. With the introduction of our second set of 1000-level lecture and laboratory classes (The Blue Planet and associated laboratory) in 2002, related to the establishment of our ENVS degree program, we saw major growth in the number of non-majors taking our classes. However, since the State of NM changed and streamlined the educational core in 2018 with implementation in Fall 2019, reducing the number of required lab science classes from 2 to 1, we have seen a significant decline in enrollments, particularly in the Blue Planet (ENVS 1130) (Figure XXX).

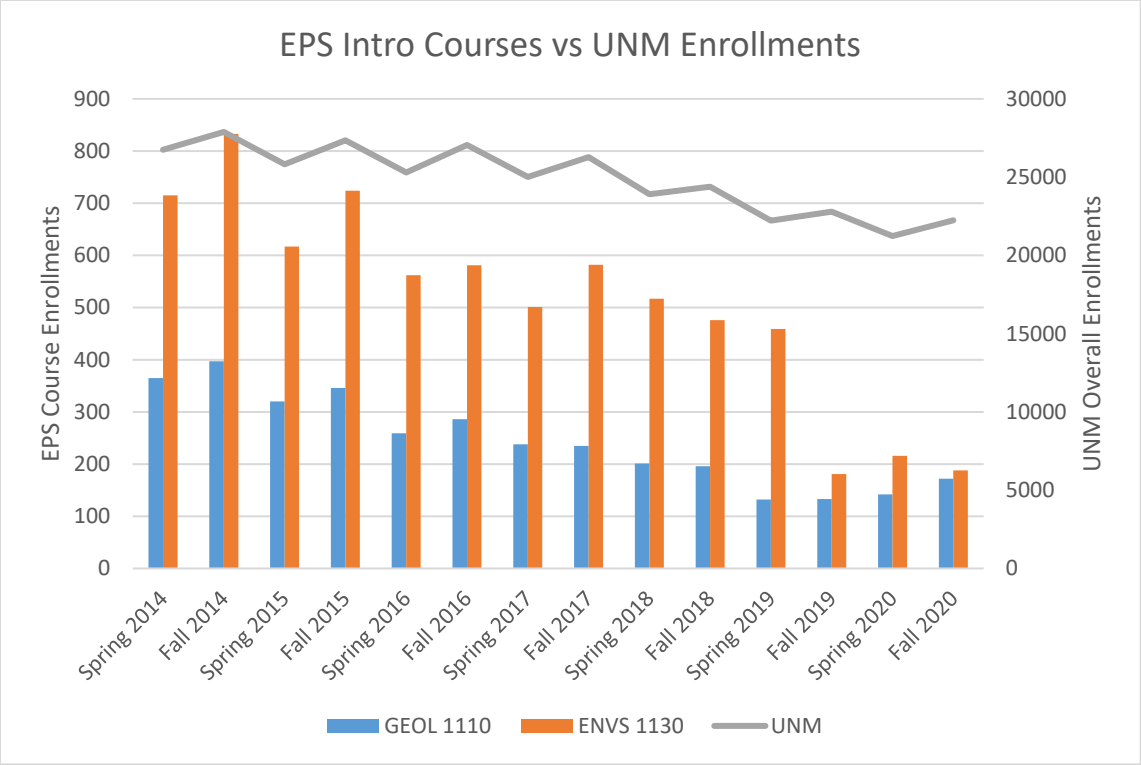

Figure 3. Enrollments in the introductory courses compared to overall enrollments at UNM. A significant drop in enrollment occurred in Fall 2019 related to the State of NM change of the educational core requirements.

Our research activities serve a significant number of important constituents both on the UNM campus and externally. They play a central role in the research mission of the University and contribute to economic development. Specifically, the department's numerous analytical laboratories provide major resources facilitating research for undergraduate and graduate students, research staff and faculty across the UNM campus including researchers from the College of Arts and Sciences, the School of Engineering and the UNM Health Sciences Center. In addition, our laboratories are utilized by researchers from other academic institutions both in and out of state, Sandia and Los Alamos National Laboratories, and numerous other private businesses ranging from small local startup companies to much larger national and, in some cases, multinational corporations. In the latter case, our analytical facilities support high-level economic development in the state by providing expertise and facilities in state-of-the-art analytical techniques important to high tech companies. In this regard, the local business community also represents an important constituent of the Department.

Other constituencies include the research community and policy makers who make use of the department's research. For example, Professor David Gutzler's research on the effect of global climate change on future water resources in New Mexico has informed policy making at the state level and his presentations to state panels provide essential scientific expertise in this longstanding debate. In addition, local, national and international news media draw extensively on the expertise of faculty and research staff in the Department for comment and analysis on scientific topics that are of interest to the general public.

The public is also an important constituent of the Department and is served in a variety of ways by the activities of the Department. Two museums located on the first floor of Northrop Hall are significant attractions for the general public, and notably for thousands of K-12 students each year (prior to the COVID pandemic). The Silver Family Geology Museum, overseen by the Department, and the Meteorite Museum managed by the Institute of Meteoritics, are both major campus attractions that draw many thousands of visitors each year. The faculty and staff of the Department and the IOM assist members of the public with the identification of fossil, rock, mineral and suspect meteorite samples on a regular basis and hence provide an important public face for the University in the local community.

Criterion 4. Students (Undergraduate & Graduate)

The unit should have appropriate structures in place to recruit, and retain undergraduate and graduate students. (If applicable, differentiate for each degree and certificate program offered by the unit). Include specific measures and activities aimed at increasing equity and inclusion.

4A: Recruitment *Discuss the unit's proactive recruitment activities for both undergraduate and graduate programs, including specific efforts focused on recruiting students of color, underserved students, and students from groups that have been traditionally under-represented in your academic field.*

Undergraduate Programs

Very few undergraduate students come to the University knowing they want to be geology majors. Though some come to UNM with the desire to be environmental science majors, our main method to recruit students into the EPS and ENVS majors is through making our introductory courses attractive. Through these courses, we not only introduce topics important for geoscience and environmental science, but we also help the students understand what fruitful and interesting careers look like in these fields. To achieve this goal, we use full-time faculty or late-stage PhD students who have the goal of teaching at the university level to teach these courses, when possible, rather than part-time instructors (PTI). When we hire PTIs to teach some sections, we work with them to build recruitment into the classes. Some faculty use resources on serc.carleton.edu to build activities around geoscience and environmental science careers. Additionally, some faculty apply concepts from Multicontext Theory to build an inclusive environment in these classes.

Once students become majors in the Department, we work to support the students through active advising and activities for undergraduate majors outside required classes. For example, each semester we offer a pizza lunch for our undergraduate majors and pre-majors. At this pizza lunch, Department faculty, our embedded College of Arts & Sciences advisor, and advisors from other programs on campus (e.g., the McNair Scholars program) are present and available for discussions with our students. Our goal of this lunch is to help students progress in their major, become aware of excellent scholarship and fellowship opportunities in the Department, and bring awareness to students of research opportunities available for them in the Department.

Graduate Programs

We have highly regarded graduate program that regularly receives over 70 applications every year, with 40% applying to the Ph.D. program and 60% to the M.S. program. Of the total applicants, we typically accept ~30 to 35% based on our Graduate Admissions Committee evaluation of background skill level, preparation for graduate level work and standardized (GRE) and written material including letters of recommendation and self-descriptive essays. Starting in 2021, the faculty have voted to eliminate the GRE requirement for application to our graduate program to help reduce barriers for underrepresented students applying to our program. Of the accepted applicants, ~40 to 50% (10-18 students/year) matriculate to our program. As we do not accept graduate students without financial support (TA, RA, GA), this limits the number of students accepted into the program each year. Some students who apply directly to the Ph.D. program without an M.S. are nevertheless considered for both degrees. Depending on the student's qualifications and how the potential advisor feels about the application, the student might be encouraged to enroll for the M.S. first, but can also be admitted directly for the Ph.D. Our graduate admissions webpage gives further details: https://eps.unm.edu/graduate/how-to-apply.html.

Our primary means of graduate student recruitment is through our collective professional activities (publishing, conference networking, personal networks) and reputation within the field. Potential graduate students are often referred to our program by colleagues at other institutions, and we have also successfully recruited graduate applicants at departmental sponsored alumni events at national meetings. We also selectively advertise in professional publications, such as *EOS* and *GSA Today*. Starting in Fall 2020, we conducted two webinar-style informational sessions that were each attended by approximately 30-40 prospective students. With our top applicants, we are often competing with other top graduate programs and here, endowed fellowships within the Department are a great advantage. The Black-EEE fellowship has also helped to recruit top graduate students and we look forward to a third endowed fellowship through the Gorham Family. The addition of health insurance to TA and RA/Fellowship financial packages has turned out to be a strong recruiting tool, as many other institutions do not yet offer health insurance. Currently we are working towards using our Graduate Scholarship Funds to support graduate students for a month in the summer (one summer funding for incoming MS students and two months for incoming PhD students over two years). We were able to do this for the first time in the summer of 2020 using a combination of dedicated alumni funds for graduate fellowships supplemented by unrestricted funds from the Ernie and Mary Rich Fund. We have also committed to future summer support included in letters of offer for our incoming graduate students.

Diversity, Equity, and Inclusion in Our Programs

Several members of our faculty actively work to attract students from underrepresented minorities in STEM (URM) into the program and help them thrive once they are in our program. Our ENVS curriculum was partially designed with concepts of Multicontext Theory (e.g., Ibarra, 2001; Weissmann et al., 2019) in mind, where systems thinking is fundamental to the approaches used. Additionally, several faculty members are involved in University programs, like the Student Experience Project (SEP) and the Expanding Course-Based Undergraduate Research

Experiences (ECURE) (https://provost.unm.edu/initiatives/lobos-connect.html), which focus on building equitable educational experiences for our students. ECURE in particular provides curriculum-based research practice for students that has been shown to improve URM engagement in faculty-led research opportunities (https://provost.unm.edu/initiatives/lobos_connect_ecure_info.pdf). In Spring, 2021, several faculty members, post-docs, and graduate students are participating in the NSF-funded URGE (Unlearning Racism in Geoscience) program to bring anti-racism practice to our programs.

Additionally, the Department committee on Diversity, Equity, and Inclusion (DEI) is working toward bringing aspects of these activities to the full department so that all faculty and students participate in DEI work. This committee developed a DEI statement that was recently approved by the Department, and a previous committee developed a clear statement on sexual harassment that was approved by the Department. These statements, along with actions supporting students, demonstrate the commitment of the Department toward DEI (see Appendix 4). Dr. Cori Myers, chair of the DEI committee has begun conversations with other DEI committee chairs from other College of Arts and Sciences STEM departments with the goal of working towards a college-wide DEI stance.

4B: Admissions *Discuss the unit's admissions criteria and decision-making processes (including transfer articulation(s)) for both undergraduate and graduate programs. Evaluate the impact of these processes on enrollment.*

For students to enter the College or Arts and Sciences, they must first complete three general education classes, including classes in communication, math, and a second language. Specific requirements for students to enter the EPS and ENVS majors include completion of either ENVS 1130 (The Blue Planet) or GEOL 1110 (Physical Geology), CHEM 1215/1215L (General Chemistry 1), and either MATH 1230 (Trigonometry), MATH 1240 (Pre-calculus), MATH 1250 (Trigonometry and Pre-calculus), or MATH 1512 (Calculus 1). As noted above, we invite declared pre-majors to our pizza lunches to help advise and attract potential majors, and we actively encourage students thinking of becoming a major in one of our programs to seek advising from faculty members. These admissions criteria have not seemed to be a limiting factor to success of students in the program.

A graduate admissions committee (currently chaired by Associate Professor Lindsay Worthington, starting in fall 2020) evaluates and ranks each graduate application. A full faculty meeting in early February is devoted to graduate admissions where top applicants are considered for available fellowships and TAs. RAs are offered by individual faculty, and we regard a mix of TA and RA support as the best option for graduate students. Several faculty actively recruit students with an eye toward building diversity in geoscience and the department plans to apply for institutional membership to the AGU Bridge program in Fall 2021, which also helps students from underrepresented backgrounds to apply to multiple institutions using a common application.

4C: Data *Provide available data and an analysis of the unit's 1) enrollment, 2) retention, and 3) graduation (i.e. time to degree, graduation rates, etc.) trends. Please provide data and analysis on enrollment, retention and graduation rates for students by race/ethnicity, gender, first*

generation, and Pell grant status, where possible. Include an explanation of the action steps or initiatives the unit has taken to address any significant challenges or issues highlighted in these trends. When possible, data should be obtained from a UNM source such as MyReports or OIA. The APR office will assist with identifying appropriate data sources.

Enrollment:

Over the past 5 years, enrollment in the graduate programs has remained relatively steady but the undergraduate degree programs have seen a steady decline (Table 1; Figure 1). The EPS degree programs typically have about 2.5 times as many students as the ENVS degree program. Declines in enrollments in our degree program match declines in overall enrollment at UNM over these years (Figure 1). Based on the numbers of graduating students over the past 10 years, our undergraduate program is approximately twice the size of our graduate program. Enrollments over the past 5 years have been higher in the EPS programs than the ENVS program. There was a significant initial drop in the number of students enrolled in the ENVS program following the restructuring of the degree, but following some modifications and streamlining the core classes in the last 2 years, we are seeing increasing enrollments in the ENVS core classes.

Table 4. Department Enrollment Rates for Fall Semester, 2016-2020, for the EPS graduate degree programs and the ENVS and EPS degree programs. Data from https://oia.unm.edu (undergraduate degrees) and MyReports.unm.edu (graduate degrees).

	2016	2017	2018	2019	2020
Grad	53	58	52	45	47
EPS	141	107	100	85	79
ENVS	86	33	29	25	32

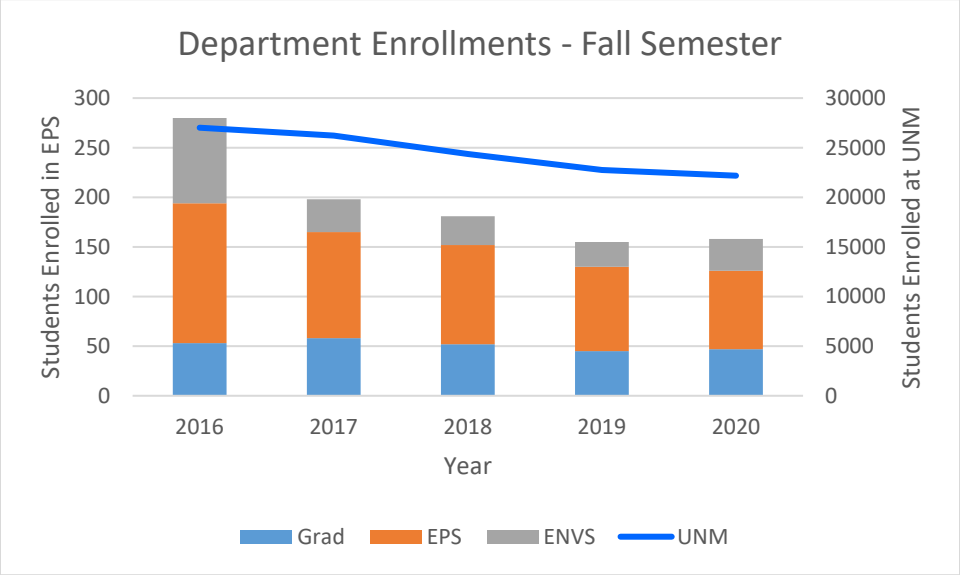

Figure 4 : Enrollment numbers for Fall Semester, 2016-2020. Data from https://oia.unm.edu and MyReports.unm.edu.

Enrollment demographics:

Our EPS degrees, including the graduate program, are on average 63% men and 37% women, while the ENVS degree program tends to have more women than men (41% men, 59% women over the past 5 years) (Tables AAA and BBB). Similarly, the EPS undergraduate degree programs tend to be about 64% white students, while the ENVS degree tends to have about 46% white students, indicating that the ENVS degree program is more attractive to a diverse population than our EPS undergraduate degree programs.

Our graduate programs in EPS do not show as much diversity as our undergraduate degree programs, with an average of 72% of MS students and an average of 70% of PhD students being white. These numbers fluctuate each semester, depending on the graduate admission pool, but they indicate that we are not attracting a very diverse demographic to the graduate programs. However, the MS program has attracted an average of 15% Hispanic students, indicated some degree of success at admitting a more diverse student body at this level. The PhD program still lacks overall diversity, with most of the non-white students (14%) consisting of international students.

Table 5. Demographics of the EPS and ENVS undergraduate majors over the past 5 years.

EPS Majors

	2016	2017	2018	2019	2020
Grand Total	155	146	131	108	99
Female	55	53	53	46	41
Male	100	93	78	62	58
American Indian	3	3	2	3	1
Asian	2	3	2	1	
Black		2	2	3	3
Hispanic	43	39	28	22	21
International	5	7	7	6	7
Two or More Races	3	2	2	1	2
Unknown	2	2		1	2
White	97	88	88	71	63

	2016	2017	2018	2019	2020	Total
Female	35.5%	36.3%	40.5%	42.6%	41.4%	38.8%
Male	64.5%	63.7%	59.5%	57.4%	58.6%	61.2%
American Indian	1.9%	2.1%	1.5%	2.8%	1.0%	1.9%
Asian	1.3%	2.1%	1.5%	0.9%	0.0%	1.3%
Black	0.0%	1.4%	1.5%	2.8%	3.0%	1.6%
Hispanic	27.7%	26.7%	21.4%	20.4%	21.2%	23.9%
International	3.2%	4.8%	5.3%	5.6%	7.1%	5.0%
Two or More Races	1.9%	1.4%	1.5%	0.9%	2.0%	1.6%

Unknown	1.3%	1.4%	0.0%	0.9%	2.0%	1.1%
White	62.6%	60.3%	67.2%	65.7%	63.6%	63.7%

ENVS Majors

	2016	2017	2018	2019	2020
Grand Total	125	91	79	81	85
Female	75	49	45	43	48
Male	50	42	34	38	37
American Indian	13	2	2	5	1
Asian	3	2	2	1	3
Black	1	3	3	1	
Hispanic	38	25	28	34	49
International	2				1
Native Hawaiian	1	2	2	1	
Two or More Races	7	4		2	1
Unknown	2	4	2		
White	58	49	40	37	30

	2016	2017	2018	2019	2020	Total
Female	60.0%	53.8%	57.0%	53.1%	56.5%	56.4%
Male	40.0%	46.2%	43.0%	46.9%	43.5%	43.6%
American Indian	10.4%	2.2%	2.5%	6.2%	1.2%	5.0%
Asian	2.4%	2.2%	2.5%	1.2%	3.5%	2.4%
Black	0.8%	3.3%	3.8%	1.2%	0.0%	1.7%
Hispanic	30.4%	27.5%	35.4%	42.0%	57.6%	37.7%
International	1.6%	0.0%	0.0%	0.0%	1.2%	0.7%
Native Hawaiian	0.8%	2.2%	2.5%	1.2%	0.0%	1.3%
Two or More Races	5.6%	4.4%	0.0%	2.5%	1.2%	3.0%
Unknown	1.6%	4.4%	2.5%	0.0%	0.0%	1.7%
White	46.4%	53.8%	50.6%	45.7%	35.3%	46.4%

Table 6. Demographic information for our Graduate programs over the past 5 years.

MS Students - Count

	S16	F16	S17	F17	S18	F18	S19	F19	S20	F20	S21
Total	23	31	30	32	36	23	19	11	9	14	15
Female	10	13	12	10	11	5	3	5	4	8	9
Male	13	18	18	22	25	18	16	6	5	6	6
Am Indian	0	0	0	0	0	0	0	0	0	0	0
Asian	0	0	0	1	1	1	1	0	0	0	0
Black	0	0	0	0	0	0	0	0	0	0	0
Hispanic	4	6	6	6	6	2	2	2	1	1	1

International	0	1	1	2	3	2	2	1	1	1	1
Native Hawaiian	0	0	0	0	0	0	0	0	0	0	0
Two or more	0	1	1	1	1	0	0	0	0	0	0
Unknown	3	2	2	0	0	0	0	0	0	0	0
White	16	21	20	22	25	18	14	8	7	12	13

MS Students - Percentage

	S16	F16	S17	F17	S18	F18	S19	F19	S20	F20	S21	AVG
Female	43	42	40	31	31	22	16	45	44	57	60	37
Male	57	58	60	69	69	78	84	55	56	43	40	63
Am Indian	0	0	0	0	0	0	0	0	0	0	0	0
Asian	0	0	0	3	3	4	5	0	0	0	0	2
Black	0	0	0	0	0	0	0	0	0	0	0	0
Hispanic	17	19	20	19	17	9	11	18	11	7	7	15
International	0	3	3	6	8	9	11	9	11	7	7	6
Native Hawaiian	0	0	0	0	0	0	0	0	0	0	0	0
Two or more	0	3	3	3	3	0	0	0	0	0	0	2
Unknown	13	6	7	0	0	0	0	0	0	0	0	3
White	70	68	67	69	69	78	74	73	78	86	87	72

PhD Students - Count

	S16	**F16**	**S17**	**F17**	**S18**	**F18**	**S19**	**F19**	**S20**	**F20**	**S21**
Total	23	22	22	26	22	29	28	34	33	33	27
Female	11	9	9	10	8	10	10	11	10	10	9
Male	12	13	13	16	14	19	18	23	23	23	18
Am Indian	0	0	0	0	0	0	0	0	0	0	0
Asian	1	1	1	1	0	0	0	0	0	0	0
Black	0	0	0	1	1	1	1	1	1	1	1
Hispanic	1	0	0	0	0	1	1	3	3	3	2
International	1	2	3	4	3	5	5	5	5	5	5
Native Hawaiian	0	0	0	0	0	0	0	0	0	0	0
Two or more	0	0	0	0	0	1	1	1	1	2	2
Unknown	1	1	1	2	2	1	1	1	1	1	1
White	19	18	17	18	16	20	19	23	22	21	16

PhD Students - Percentage

	S16	F16	S17	F17	S18	F18	S19	F19	S20	F20	S21	AVG
Female	48	41	41	38	36	34	36	32	30	30	33	36
Male	52	59	59	62	64	66	64	68	70	70	67	64
Am Indian	0	0	0	0	0	0	0	0	0	0	0	0
Asian	4	5	5	4	0	0	0	0	0	0	0	1
Black	0	0	0	4	5	3	4	3	3	3	4	3
Hispanic	4	0	0	0	0	3	4	9	9	9	7	5
International	4	9	14	15	14	17	18	15	15	15	19	14
Native Hawaiian	0	0	0	0	0	0	0	0	0	0	0	0

Two or more	0	0	0	0	0	3	4	3	3	6	7	3
Unknown	4	5	5	8	9	3	4	3	3	3	4	4
White	83	82	77	69	73	69	68	68	67	64	59	70

Retention Rates

Retention rates are reported by the university (https://oia.unm.edu) for incoming first-year students who declare a specific major, and these rates are shown in Table XXX and Figure 2. Overall, the retention rates of students in our undergraduate degree programs are either better than or about the same as the overall UNM retention rates, indicating our undergraduate degree programs are doing well at keeping our students in our degree programs who come to UNM declaring to be ENVS or EPS majors.

Table 7. Retention rates for EPS and ENVS degree programs compared to overall retention rates at UNM.

Year	UNM	EPS	ENVS
1	100%	100%	100%
2	88%	94%	91%
3	75%	82%	72%
4	69%	73%	66%
5	63%	68%	59%
6	60%	62%	59%
7	56%	60%	55%
8	53%	56%	55%
Grand Total	72%	76%	71%

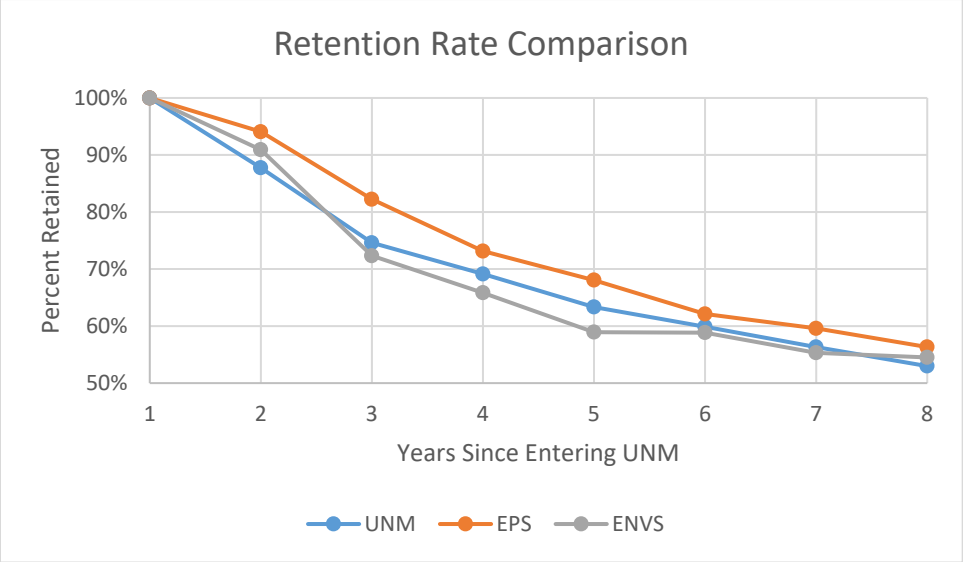

Figure 5. Retention rates for first-year cohorts who declared interest in the EPS and ENVS majors compared to overall retention rates for UNM.

These data are very difficult to interpret for actual retention indicators since most of our majors for the EPS and ENVS degrees are attracted to the program in our 1000-level courses. Therefore, students who discover our degree programs in their first or second year are not included in these retention rates. Since many students come to the University without knowledge of what their actual major will be, and many students change majors in their first two years, we do not believe these numbers accurately reflect actual success of students in our program.

Tracking of actual retention in the ENVS program is difficult; however, anecdotally we believe that students often find the Calculus and Physics requirements to be a barrier to completing the degree programs. Many of our students take these classes at a community college and tend to have better success in completing the requirement. With data available, we cannot determine whether the BA-EPS has a higher retention rate than the BS-EPS, but anecdotally we have heard that students who prefer a BS but cannot successfully complete the math requirements will shift to the BA in order to complete their degree in EPS. This is our motivation for developing a BA in ENVS. Unfortunately, students who do not complete the calculus and physics will have limited opportunities to continue into graduate school, and many of the jobs in EPS and ENVS require a MS degree.

Graduation Rates

As with the retention rates, graduation rates are reported by the university (https://oia.unm.edu) for incoming first-year students who declare a specific major, and these rates are shown in graphs in Table YYY. These data are very difficult to interpret for actual graduation rate indicators since most of our majors for the EPS and ENVS degrees are attracted to the program in our 1000-level courses. Therefore, students who discover our degree programs in their first or second year are not included in these graduation rate statistics. Since many students come to the University without knowledge of what their actual major will be, and many students change majors in their first two years, we do not believe these numbers accurately reflect actual success of students in our program.

Table 8. Graduation rates for the ENVS and EPS degree programs:

EPS Majors

Entry year	Semester in Residence																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2010	0	0	0	0	0	0	0	50	50	66.7	83.3	83.3	83.3	83.3	83.3	83.3	83.3	83.3	83.3	83.3
2011	0	0	0	0	0	0	0	14.3	28.6	42.9	42.9	57.1	57.1	57.1	57.1	57.1	57.1	57.1		
2012	0	0	0	0	0	0	0	33.3	33.3	50	50	66.7	66.7	66.7	66.7					
2013	0	0	0	0	0	0	0	10	20	30	30	30	30	30						
2014	0	0	0	0	0	0	0	20	20	20	20	20								
2015	0	0	0	0	0	9.1	9.1	27.3	27.3	27.3										
2016	0	0	0	0	0	0	0	0												
2017	0	0	0	0	0	0														
2018	0	0	0	0																
2019	0	0																		

ENVS Major

Entry year	Semester in Residence																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2010	0	0	0	0	0	0	0	12.5	37.5	68.8	68.8	75	75	75	75	75	75	75	75	75
2011	0	0	0	0	0	0	4.3	13	21.7	34.8	34.8	39.1	39.1	39.1	39.1	39.1	39.1	39.1		
2012	0	0	0	0	0	0	0	6.3	25	25	31.3	31.3	31.3	31.3	31.3	31.3				
2013	0	0	0	0	0	0	0	37	44.4	59.3	59.3	59.3	59.3	59.3						
2014	0	0	0	0	0	0	8	32	56	64	64	72								
2015	0	0	0	0	0	7.4	7.4	33.3	44.4	51.9										
2016	0	0	0	0	0	4.2	8.3	37.5												
2017	0	0	0	0	0	0														
2018	0	0	0	0																
2019	0	0																		

As indicated in the retention rate discussion, we have heard anecdotally that the math and physics classes increase the time to graduation for a significant number of our students. Many of our students need to take these classes multiple times before they successfully complete the courses. This delays time to graduation, and for many this will lead to lack of success in completing the major.

On average, each year the Department graduates 3 PhDs, 10 MS, 7 BA-EPS, 15 BS-EPS, and 12 BS-ENVS students (between 2016-2020). Of the undergraduates who graduate from our Department, an average of 26% complete a senior thesis. Table ZZZ below shows the numbers of graduates in each category for the past five academic years, with Figures 4 and 5 showing graduation numbers over the past 5 years.

Table 9. Numbers of students graduating from each of the programs operated by EPS.

	Academic Year					
	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	Averages
PhD	5	3	5	1	2	3.2
MS	9	9	8	16	9	10.2
BA-EPS	7	7	8	7	6	7
BS-EPS	9	28	13	16	10	15.2
BS-ENVS	11	17	14	9	9	12
SR theses	9	13	7	10	5	8.8
% sr thesis		33.3	25	20	31.3	20

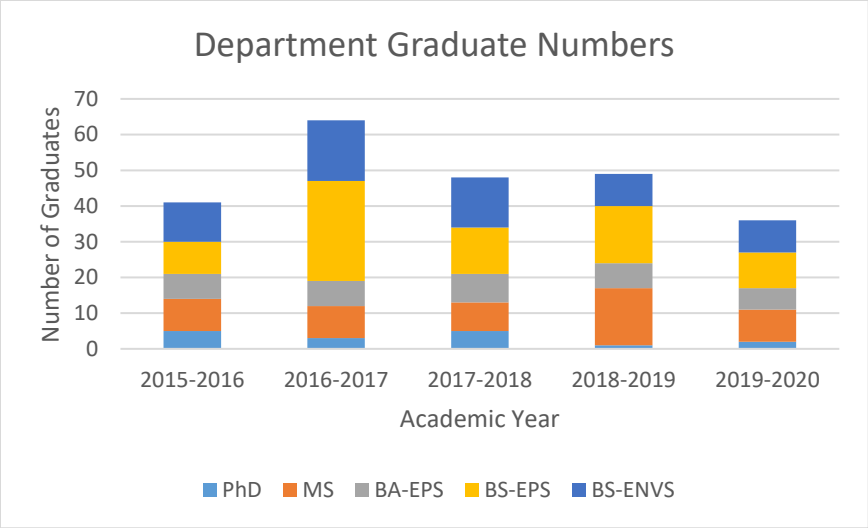

Figure 6. Graduation numbers by degree for the Department of Earth & Planetary Sciences over the past 5 academic years.

Time-to-degree:

Another measure of success in the program is time-to-degree. We measured this as an average time to degree for our graduating seniors in our undergraduate programs. In Table 10, we report time to degree for the undergraduate degree programs. Given the database restrictions, we could not distinguish BA versus BS majors in EPS. This table indicates that our EPS majors take more time to complete their degrees, on average than our ENVS majors. Reasons for the long average time to degree for EPS majors is unclear and needs to be evaluated in the future.

Table 10. Time to degree for the undergraduate majors (years). Given the database restrictions, we could not distinguish the BA versus BS in EPS majors.

	EPS	ENVS
Overall Average	5.5	4.1
Female	6.9	4.0
Male	4.6	4.3
American Indian	3.9	4.3
Asian	4.4	4.3
Hispanic	4.8	4.4
Non-Res Alien	4.8	3.8
Race/Ethnicity Unknown	6.4	4.9
Two or More Races	5.0	2.9
White	6.0	4.0

4D: Advisement Practices *Discuss the unit's advisement process for students, including an explanation of how the unit has attempted to improve or address issues regarding its advising practices and to ensure inclusiveness and equity in advising.*

Two faculty advisors, Dr. Gary Weissman and Dr. Laura Crossey, actively advise students on classes within the Department that support the student's interests. Ms. Maggie Summruld is our

CAS advisor and has a renovated office in Northrop Hall next to the undergraduate lounge / Geology and Environmental Science Club to promote easy access for our undergraduates to an advisor. She provides appointments and walk-in service for advising on a published schedule (now all online with COVID closures). As mentioned above, we also conduct programming, like the pizza lunches, to advise our undergraduate students.

Graduate students are advised by their faculty advisors and committees along with the chair of the graduate committee (currently Dr. Brandon Schmandt). Students are introduced to graduate degree requirements and timelines during orientation week of their first semester. Subsequently, most advising occurs via interactions with their primary advisor and their committee, which is formed in the first semester. Comprehensive exam performance is evaluated by the student's committee and an 'outside' faculty member selected by the Department Chair. Throughout each degree program, if a student and their advisor or committee are confronted with difficult circumstances or decisions, the Graduate Committee Chair will engage in individual or group meetings to consider options and foster productive communication. Petitions for exceptions to normal graduate program policies are handled on case-by-case basis with initial consideration by the Graduate Committee usually leading to a recommendation that is discussed by the full faculty before choosing a course of action. This degree of flexibility guided by discussions among the faculty is important for accommodating each student's unique circumstances while maintaining fairness and promoting high educational standards that prepare students for their subsequent careers.

4E: Student Support Services *Discuss any student support services that are maintained by the unit and evaluate the relevance and impact of these services on students' academic success.*

Undergraduate students in the program are supported through various means to help them attain success in completing the program. Advising occurs both in formal advising sessions and in core classes taught in the Department.

We also support students financially through several alumni-supported scholarships and fellowships. Generous donations allow us to offer $2000/semester support to students participating in undergraduate research or teaching through the Leonard Research Fellowship and Leonard Undergraduate Educator Fellowship. Prior to the Coronavirus pandemic, we were typically supporting 8-15 students under these programs. Our primary goal in these programs is to offer students sufficient support so they can focus on their academic training rather than work at places outside the University. Additionally, the Department is able to support students with approximately $12,500 in scholarships that is spread among our undergraduate majors. Students apply for these funds each spring and we offer scholarships to most students who apply.

During the Coronavirus pandemic, the Department worked to increase funding support to students through use of alumni donations and loans of laptop computers. Many of our classes use ArcGIS for activities and labs, and this software is only available for PCs. The Department has a set of older PCs that we were able to check out for student use during the pandemic if the computers they had could not run needed software for the classes.

Graduate students are only admitted to the MS and PhD programs if they are provided financial support through Teaching Assistant (TA) and/or Research Assistant (RA) appointments. Many students rotate between these forms of financial support during their degrees. Currently, students in the Department benefit from 18 TA positions (0.5 FTE), but the total will be reduced to 16 in 2021-2022. The average number of graduate students in the Department typically ranges from ~45-55, thus ~30 students are typically supported through RA appointments funded by faculty research projects or competitive fellowships. Mixing support from TA and RA resources enables the faculty to leverage grant resources to achieve total enrollment levels necessary for a healthy graduate curriculum including peer-to-peer learning as well as faculty instruction and research mentoring. In addition to the base level of financial support through TA and RA appointments, the Department annually awards about $40,000 in graduate scholarships spread across all students in good standing along with increased allocations for a small number of merit-based awards to recognize exceptional research and teaching accomplishments. Scholarship funds help ensure that students have at least partial support to continue their research through the summer.

The Office of Graduate Studies (OGS) has several initiatives that provide excellent support services and professional development opportunities for graduate students: including TA workshops, proposal- and paper-writing 'boot camps', and research ethics training. We strongly encourage all of our graduate students to take advantage of these opportunities. Recently, a cohort of graduate students has started to "pay it forward" by engaging with our undergraduate students to help them prepare for graduate school applications and for careers in the geosciences. They have helped sponsor events like a pizza evening to discuss graduate school applications, how to write effective personal letters, and how to ask faculty for references. We have also had 1-2 events per semester including sponsoring pizza lunches where local professionals from industry, the U.S.G.S., and national labs have come to talk with both graduate and undergraduate students about careers. (The in-person events obviously were paused with the COVID pandemic.) Graduate students and faculty have actively participated in a student-run organization, Advancing Womxn in Geosciences (@UNM_AWS), including lunch-time presentations and Q&A sessions with outside speakers as well as recent zoom presentations by some of our recent female graduates.

Our graduate students are also very successful at obtaining external funding through small student grant opportunities both within UNM, from professional societies and state organizations, and from government funding agencies (NSF, NASA, etc). We nominate our graduate students for TA awards University wide, and each year the Department selects a best TA and "rookie TA of the year" award. We have actively promoted our graduate students for university wide awards including the Susan Deese Roberts Teaching Excellence Award (two of our graduates have won this award, Camille Dwyer and Ben Burnett).

4F: Graduate Success *Discuss the success of graduates of the program by addressing the following questions:*

- *How does the unit measure the success of graduates (i.e. employment, community engagement, graduate studies, etc.)?*
- *What are the results of these measures?*
- *Discuss the equity of student support and success across demographic categories.*

Success of the MS and PhD programs is tracked each year by completing an assessment of Student Learning Outcomes (SLO) for each program. A three-year cycle is used such that a subset of SLO's is evaluated each year and all are evaluated within any three-year interval. Assessments of SLO's is linked to student performance in comprehensive exam components regarding design and implementation of scientific research, science communication experience at conference or professional meetings, and communication of research results through peer-reviewed publications, maps, or technical reports. For example, in Academic Year 2019-2020 we assessed SLO's related to presentation experience and publication of research results. In the PhD program, one benchmark is that we expect >75% of students to publish a peer-reviewed journal article, map, or professional report within three years of graduation. This benchmark was met given that 100% (8/8) PhD graduates in the previous three years published peer-reviewed research products and presented their research at major conferences. Our MS and PhD programs consistently meet their benchmarks. Annual assessments provide updates to ensure that high performance continues and serve as an occasion to update tracking of information such as the research products, presentations, and current employment of our recent graduates.

Unfortunately, the Department does not have sufficient resources to follow the employment placement of graduates from our B.S. and B.A. programs and so our data in these areas are incomplete and are generally gained from personal communication. Our tracking of placement of students is shown (by degree) in Appendix 5. In contrast, we have much more complete data on the career paths followed by our M.S. and Ph.D. graduates.

Our data show that B.S. and B.A. graduates follow a variety of different career paths. Many graduates find employment that makes direct use of the skills that they have acquired during their degree programs and include education, local government and state agencies, national agencies (e.g., USGS) and national laboratories, as well as in the private sector in environmental consulting companies and the exploration/extraction industries. A number of students enter employment in a variety of other sectors including management and retail businesses, journalism, non-profit advocacy organizations and, in some cases, establish their own businesses. A significant number of undergraduate students move on to graduate school. A detailed discussion of the placement of our M.S. and Ph.D. graduates is presented later, but includes positions in academia (postdoctoral and faculty position), oil, gas and mineral exploration and extraction, research and technical positions in national laboratories; local, state and national government agencies; private consulting companies and in the case of M.S. students, matriculation to Ph.D. programs. Many of our M.S. students stay in New Mexico and go on to work for local industry, environmental consulting companies, the New Mexico Bureau of Geology and Mineral Resources and even local national labs including Sandia National Laboratories and Los Alamos National Laboratories. Many of our recent Ph.D. students have gone on to faculty positions at other institutions (e.g. Utah State University, University of Texas Austin, University of Texas El Paso, University of California Santa Barbara, West Texas A&M University) or post-doctoral fellowships at other institutions. Some of our Ph.D.s have also gone on to work for the NMBGMR, the U.S. Geological Survey, and some have even started up their own consulting businesses.

Criterion 5. Faculty

The faculty (i.e., continuing, temporary, and affiliated) should have appropriate qualifications and credentials and be suitable to cover the curricular requirements of each degree/certificate program.

5A: Composition *After completing the Faculty Credentials Template (Appendix 6), discuss the composition of the faculty and their credentials (i.e. proportion of senior versus junior faculty, proportion of women and underrepresented faculty, etc.). Provide a link to the faculty vitae.*

As of January 1, 2021, the department has 18 faculty members with a higher proportion of senior faculty (12 senior: 4 Distinguished Professors and 7 Full Professors, 1 Principal Lecturer) compared with 4 Assistant Professors and 2 Associate Professors. All of our faculty, including our Principal Lecturer, have PhDs. The department has 13 male and 5 female faculty members, and one Black, one Hispanic/Asian, one Hispanic and one Asian. Of our last 6 hires since 2013, three are female and three are male. The EPS faculty and their research interests are shown on our faculty webpage: https://eps.unm.edu/people/faculty/index.html. Faculty CVs are shown in Appendix 7.

5B: Course-Load *Explain the process that determines and assigns faculty course-load (i.e., how many courses do faculty teach per semester, how does the unit determine faculty assignment to lower division vs. upper division courses, etc.). Describe the faculty-to-student and faculty-to-course ratio, and any impacts this has on unit success.*

All of our faculty participate in teaching, research, and service. Our nominal classroom teaching loads are 3 courses per year (2 and 1 load) and all of our tenure track faculty teach a mix of lower and upper division classes. Course load reductions are granted during administrative appointments (e.g. EPS Chair, IOM Director) and for extraordinary external service such as serving as an editor for a major journal, or as a distinguished lecturer for a professional society necessitating frequent travel. The faculty regularly discuss which classes need to be covered for our three undergraduate majors and our graduate students in a planning session near the start of each semester (e.g. spring) for the following year. Our Principal Lecturer (Pun) teaches classes at the 1000-level (mainly GEOL 1110) and runs the lab classes (developing materials, overseeing TAs) for GEOL 1110L and ENVS 1130L. Junior and Senior faculty regularly alternate between teaching the introductory level classes, upper level core or elective classes and graduate lecture or seminar classes. With recent retirements and no replacements for these faculty lines, we struggle to meet all of these commitments with the number of faculty on hand at present. For example, many graduate classes are provided as a combined 400/500 level with a combination of senior undergraduates and graduate students. This makes it harder to deliver course material at a high level for graduate students and reduces the variety of both upper-level undergraduate and graduate level classes.

5C: Professional Development *Describe the professional development activities for faculty within the unit, including how these activities are used to sustain research-related agendas, quality teaching, and students' academic/professional development at the undergraduate and graduate level. Describe what measures the department takes to ensure appropriate support,*

mentoring, workload and outcomes for faculty of color and members of groups that are traditionally under-represented in your field.

Most faculty use the opportunity of the University sabbatical leave policy to provide professional growth and increased competence in a new or continuing area of significant research, foster new collaborations and explore new areas, and to rejuvenate teaching approaches. Ongoing professional development opportunities for new faculty have been expanded within UNM: through the College of Arts & Sciences, orientation programs now provide information on teaching and grant opportunities, P/T guidelines, and seed money. Occasionally the College has provided competitive options for a 'Research Semester' for Assistant Professors and our faculty has benefitted from these opportunities. UNM's Center for Teaching and Learning (CTL) provides ongoing teaching and learning strategies (including training to successfully transition to remote instruction during the past year) for both new and experienced teachers, often utilizing peer teaching instruction and workshops. Some faculty members have also been involved in University fellowships that focus on building stronger common core classes, including the Provost's Core Curriculum Teaching Fellowships, the Student Experience Project (SEP), and the Expanding Course-Based Undergraduate Research Experiences (ECURE) program (Gary Weissmann and Cori Myers are involved in these programs). Finally, EPS faculty have participated in UNM-wide discussions to enhance STEM research experiences through the Associate Affairs General Education (AAGE) Fellowship program offered in conjunction with programing goals of the Associate Provost for Student Success (Dr. Pamela Cheek) in the Academic Affairs Administration.

Mandatory institutional training has become more regularized, with the online capabilities and requirements for ethics, harassment, and specific training for faculty with student advisement responsibilities and grant management requirements. EPS participation in the NSF URGE program also provides additional opportunities for remote training in promoting diversity, equity, and inclusion.

Externally, many faculty take advantage of opportunities and workshops on best practices and pedagogy through the professional societies such as the National Association of Geoscience Teachers, Geologic Society of America, and the American Geophysical Union.

Criterion 6. Research, Scholarship, & Service

The unit should have structures in place to promote active engagement in research, scholarly, and creative works among the faculty and students (if applicable, differentiate for each undergraduate and graduate degree and certificate program).

6A: Scholarly & Creative Works *Describe the scholarly/creative works and accomplishments of the faculty. Explain how these support the quality of the unit; what are particular areas of strength?*

EPS faculty, research staff and students (graduate and undergraduate) are highly involved in a wide range of research across the broad fields of earth, planetary, and environmental sciences. Much of this work is externally funded and the department is extraordinarily active in publishing the results in leading journals in the fields and general journals, including high-visibility journals including *Science*, *Nature*, and *Proceedings of the National Academy of Sciences* (PNAS). All of

the department faculty strive to publish high-impact research on their own work, and we are especially proud of the number and quality of papers that our graduate students publish each year. For both our MS and our PhD programs, we encourage students to prepare their work as a published work rather than traditional chapters of a thesis, and the high acceptance rate of graduate student first authored papers is a testament to the strength of EPS research quality. We are also proud of the fact that we have a very strong undergraduate research program where we work to introduce students to field work, lab work, and data collection in an honors thesis setting. There is no expectation that this work will lead to a peer-reviewed publication; however, we have had several undergraduates as co-authors on a wide range of papers. In addition to peer-reviewed publications, members of the department are extremely active in professional society meetings with numerous talks / posters at national and international conferences. We encourage our graduate and even some undergraduate students to present their findings at these meetings.

The department is nationally and internationally recognized for the quality of our faculty and our graduate program and a large part of that is the overall quality of our scholarly works. The biggest factor is the excellence of the faculty and the graduate students, and a second is the excellence of our research facilities. Over the last several decades, departmental faculty and research scientists (including those in the Institute of Meteoritics) have worked tirelessly to develop world class labs that help attract external funding, external collaboration and allow for cutting edge research. Our facilities and capabilities are described extensively in Criterion 9. We make it a point to expose our graduate students to as many facilities as possible (classes, research) to give broaden their skillsets. All of our faculty are also extremely active in incorporating the results of their own research into the classes that they teach – and we draw from each other's research findings for teaching material.

The department has a number of areas of strength that include: Geochemistry/Petrology/ Mineralogy, Geophysics/Seismology, Tectonics/Structural Geology, Climate and Surface Processes, Sedimentary Geology, Planetary Sciences, Volcanology, and several faculty have research interests that straddle many of these broad categories. Detailed descriptions of each faculty members research are included in the CVs as part of Appendix 7, and on our departmental website: https://eps.unm.edu/people/faculty/index.html (tenure-track faculty) as well as our research faculty and research scientists: https://eps.unm.edu/people/faculty/research-professors.html, and https://eps.unm.edu/people/faculty/research-scientists.html.

6B: Research Expenditures *If applicable, include a summary of the unit's research related expenditures, including international, national, local, and private grants/funding. How is faculty-generated revenue utilized to support the goals of the unit?*

EPS and IOM faculty and research professors are extremely active in seeking extramural support for their research programs, analytical facilities and support for graduate and undergraduate students. Faculty have obtained research funding from agencies including the National Science Foundation (NSF), NASA, NOAA, Carnegie Foundation, and the American Chemical Society Petroleum Research Fund (ACS-PRF) etc. Total grant expenditures for the last 5 years are shown in Table 1, along with other STEM departments in the College of Arts and Sciences. Note that EPS expenditures are only part of the total as some EPS faculty (e.g., Sharp, Fawcett, Elrick) are listed under the Center for Stable Isotopes (CSI) and other faculty members are listed under the

IOM. Dr. Jin Zhang has a split FTE with half in EPS and half in IOM, however, her grant expenditures are listed with IOM. Dr. Carl Agee, director of the IOM has all of his grant activity listed under IOM, including the substantial COMPRESS grant. (Data in Table 1 is from the College of Arts and Sciences.)

Table 11: Contract and Grant Expenditures for STEM Departments and Centers for Last 5 Years (EPS, CSI and IOM highlighted).

Department or Center	AY15-16 Grant Expenditures	AY16-17 Grant Expenditures	AY17-18 Grant Expenditures	AY18-19 Grant Expenditures	AY19-20 Grant Expenditures	Total Grant Expenditures Last 5 Years
Anthropology Department	$1,443,411.00	$1,380,924.12	$1,856,733.00	$1,663,723.00	$1,413,910.02	$7,758,701.14
Biology Department	$10,959,759.00	$11,251,352.80	$11,253,647.00	$10,312,893.00	$9,785,894.90	$53,563,546.70
Chemistry Department	$2,618,816.00	$2,758,650.50	$3,287,111.00	$1,809,096.00	$2,366,064.65	$12,839,738.15
Earth and Planetary Sciences Dept	**$1,542,763.00**	**$1,988,702.43**	**$2,049,380.00**	**$1,866,411.00**	**$1,944,119.77**	**$9,391,376.20**
Geography Department	$541,716.00	$251,314.03	$252,855.00	$120,034.00	$99,494.00	$1,265,413.03
Mathematics Statistics	$759,487.00	$701,414.14	$537,057.00	$996,755.00	$536,030.14	$3,530,743.28
Physics Astronomy Department	$4,775,318.00	$4,951,934.15	$4,780,939.00	$4,486,886.00	$4,614,413.16	$23,609,490.31
Psychology Department	$713,457.00	$1,729,762.55	$2,252,796.00	$1,827,490.00	$2,002,004.63	$8,525,510.18
Speech and Hearing Sciences	$90,789.00	$148,144.42	$698,985.00	$617,365.00	$559,776.86	$2,115,060.28
Center for Research Env Sci&Tech	$764,140.00	$461,153.00	$500,024.00	$519,215.00	$101,388.51	$2,345,920.51
Center for Stable Isotopes	**$308,456.00**	**$547,941.39**	**$811,121.00**	**$853,949.00**	**$803,499.95**	**$3,324,967.34**
Earth Data Analysis Center	$1,505,534.00	$1,473,563.86	$1,147,148.00	$1,363,180.00	$955,574.53	$6,445,000.39
Institute of Meteoritics	**$2,238,513.00**	**$3,834,449.22**	**$3,438,127.00**	**$3,151,049.00**	**$3,201,436.85**	**$15,863,575.07**
Maxwell Museum	$80,786.00	$283,121.79	$74,278.00	$123,615.00	$72,186.38	$633,987.17
Office of Contract Archaeology	$1,614,178.00	$1,166,426.10	$1,113,481.00	$1,273,894.00	$1,045,598.83	$6,213,577.93

The total EPS, CSI and IOM grant expenditures over the last 5 years sum to $26.7 million with EPS expenditures totally $9.4 million, the EPS portion of CSI ~$1.5 million (CSI also includes grant expenditures from Biology faculty and Anthropology faculty not included here), and the IOM with $15.8 million in expenditures (much of this from the COMPRESS program). By itself, EPS (and EPS CSI) is the fourth largest department in total expenditures (following Biology, Physics and Astronomy and Chemistry and Chemical Biology) and combined EPS and IOM grant expenditures are the second largest in the College. On a per capita basis, EPS/IOM faculty are among the top producers in the College in raising and spending external grant funds.

Research expenditures support many goals of the Department including conducting world class research, support for faculty (including summer salary for Tenure Track faculty and a portion of the base salary for some research faculty and staff), support for graduate and undergraduate students (Research Assistantships), support and upkeep of our research laboratories and facilities (through negotiated cost centers and set fees for services charged to grants), and outreach / broader impacts as part of NSF grant activity. We currently support about half of our graduate

student population with RAs from external grants (most graduate students are now supported with a mix of TA and RA funding) which has allowed us to greatly expand our graduate program and generate additional tuition dollars for the University. Our research program and activities are tightly linked to our teaching activities including classes on use of the analytical facilities (with students from across Colleges participating), and research findings are incorporated into our curriculum. Our research active faculty are on top of the latest findings in the Earth Sciences and strive to update our class material each semester.

EPS and IOM external grant activity has raised substantial Facilities and Administrative (F&A) revenue for the University with a yearly breakdown shown in Figure 2. On average, EPS generates ~$600,000 per year in F&A while the IOM generates ~$450,000 per year. Despite a net loss of 3 faculty in EPS, F&A generation does not exhibit a negative trend, showing that our productivity per capita is increasing. The Department has also benefitted from NSF and NASA-funded Instrumentation & Facilities Awards as well as Major Research Infrastructure grants. Those awards, as well as graduate training grants, do not provide significant F&A yet represent a major contribution to the Department and University Activities – particularly as so many of our facilities have users from across campus.

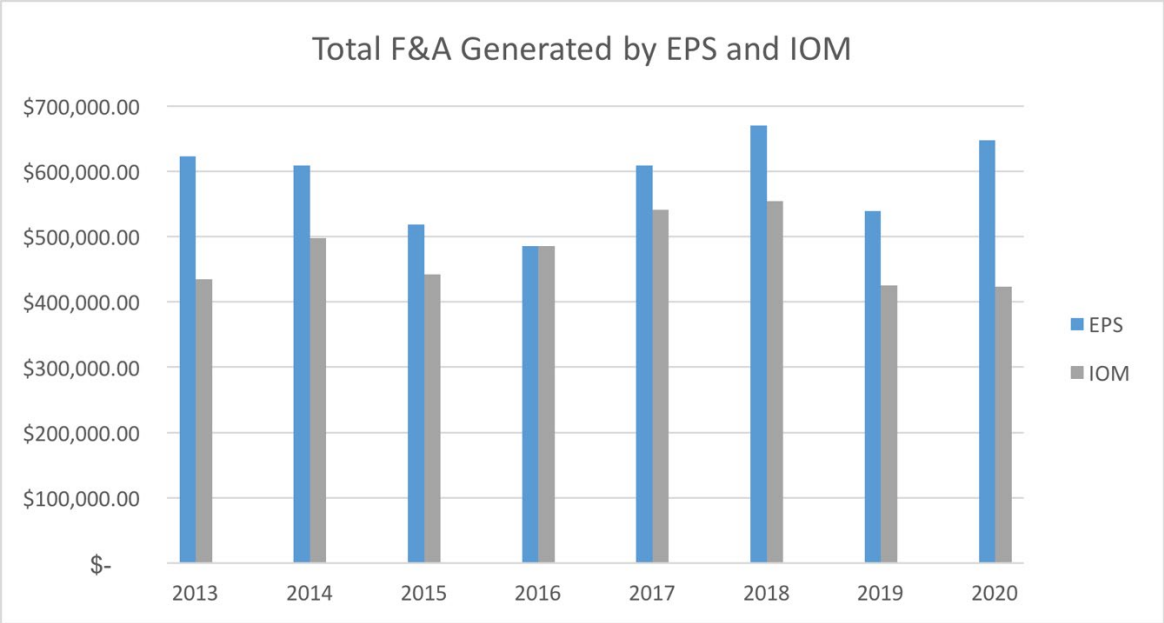

Figure 7: Total overhead return (F&A) to the University generated by the Department (including the EPS portion of CSI) and by the Institute of Meteoritics (IOM).

6C: Research Involvement *Give an overview of the unit's involvement with any research labs, organizations, institutes, or other such centers for scholarly/creative endeavors (i.e. formal partnerships with Sandia Labs, CHTM, community organizations, local media, etc.).*

EPS faculty and graduate students are heavily involved with many research labs, organizations, and centers both within UNM and with several external organizations. Dr. Adrian Brearley is an Associate Director of Center for Micro Engineered Materials (CMEM), a category 3 research

center that reports directly to the Office of the Vice President for Research and includes collaborators from the College of Engineering. Several faculty are involved in the Sustainable Water Resources Grand Challenge at UNM including Dr. Laura Crossey and Dr. Tobias Fischer.

Our Geophysics faculty are highly involved in several professional organizations. Dr. Brandon Schmandt is a Board Member for the Incorporated Research Institute for Seismology (IRIS) and Dr. Eric Lindsey is a member of UNAVCO, a non-profit university-governed consortium that facilitates geoscience research and education using geodesy. Dr. Lindsay Worthington and Dr. Brandon Schmandt have funded involvement with the Sandia National Lab and AFRL nuclear explosion monitoring research teams. Dr. Lindsay Worthington was the 2019-2020 Distinguished Lecturer for the U.S. Ocean Discovery Program as part of the International Ocean Discovery Program (IODP), Dr. Laura Crossey was the 2019 GSA Hydrogeology Division Birdsall-Dreiss Distinguished Lecturer. Dr. David Gutzler (retired as of Dec 31, 2020) is a Lead Author on the 6th Assessment, Working Group II, Ch. 14 (North American Climate Impacts) of the UN Intergovernmental Panel on Climate Change (IPCC) and served as a Lead Author for the 5th Assessment, Working Group I, Ch. 10, 2010-2013. Dr. Karl Karlstrom and Dr. Laura Crossey are highly involved in research and outreach at the Grand Canyon National Park including establishing the award winning "Trail of Time" display. Dr. Carl Agee is the director of the NSF-funded COMPRESS consortium with several universities (described later in this document). Dr. Tobias Fischer is a member of the National Academies/National Research Council committee on improving the understanding of volcanic eruptions and the Chair/PI of the NSF-funded Community Network for Volcanic Eruptions Response (CONVERSE). This research coordination network (RCN) aims to facilitate the coordination of federal agencies with academic researchers to respond to volcanic eruptions in the US to maximize scientific return. He is also on the steering committee of the Subduction Zones in 4D (SZ4D) initiative, another NSF-funded research coordination network.

Our research labs include many outside collaborations and involvement. For example, our Analytical Chemistry lab (supervised by Dr. Mehdi Ali) collaborates with the New Mexico State Laboratory Division (SLD) on analytical methods and with the U.S. Geological Survey on water and soil quality testing. The lab is also participating in the U.S.G.S. Round Robin studies as part of Analytical Chemistry Laboratory Quality Assurance and Quality Control. Our students perform research at both Sandia National Laboratories and Los Alamos National Laboratory. For example, one of Dr. Tobias Fischer's student is currently working at SNL to develop tools to investigate gas migration through fracturing rock while another is working at LANL to identify processes that lead to volcanic lightning. Both are supported by funding from these national laboratories. Our faculty also collaborates with faculty in other departments and colleges. For example, a joint grant from the NSF National Robotics Initiative currently funds faculty and students in EPS, Computer Science, Computer Engineering and Biology to develop bio-inspired algorithms for drone swarms to map volcanic CO_2 emissions and CH_4 leaks from pipelines. Our faculty also has funding from the NSF-NERC joint program that enables close collaboration between US and UK scientists. Both departmental faculty and IOM research scientists (e.g. Dr. Horton Newsom) collaborate with Mars missions including the Curiosity Rover and the new Perseverance Rover with NASA and JPL scientists. Another recent collaboration between EPS (Sharp), IOM (Dr. Charles Shearer) and NASA involves the study of unopened lunar regolith

core samples taken in vacuum tubes by the Apollo 15 through 17 missions. Also joining this team is Apollo 17 astronaut and geologist Harrison Schmitt.

Consortium for Materials Properties Research in Earth Science (COMPRES)
COMPRES is a community-based consortium whose goal is to enable Earth Science researchers to conduct the next generation of high-pressure science on world-class equipment and facilities. The consortium facilitates the operation of synchrotron beamlines, the development of new technologies for high-pressure research, and both supports and advocates for science and educational programs. The facilities that COMPRES supports are specialized for high-pressure research using a variety of instruments. The goal is to provide facilities that are needed for cutting-edge innovative research that can only be performed at specialized central facilities. UNM has been the home institution for COMPRES since 2015 and the Central Administrative Office resides with the Institute of Meteoritics (IOM). Currently, this project is funded at the level of $12,000,000 for the period 2017-2022 by a cooperative agreement with the National Science Foundation (NSF). Carl Agee is President of COMPRES is the Chief Executive Officer of the organization and executes all contracts and agreements on behalf of the organization and carries out the directives of the Electorate. In relationship to the NSF Cooperative Agreement, the President of COMPRES also serves as the Principal Investigator.

The COMPRES Central Office oversees facility sub-awards to University of California, Santa Cruz, Stony Brook University, University of Hawaii, University of Chicago, and University of Illinois, Chicago at three DOE national synchrotron facilities: Advanced Light Source (ALS) at Lawrence Berkeley National Laboratory, Advanced Photon Source (APS) at Argonne National Laboratory, and National Synchrotron Light Source-II (NSLS-II) at Brookhaven National Laboratory. COMPRES also manages an "offline" sub-award facility at Arizona State University, and Education Outreach and Infrastructure Development (EOID) sub-awards at Princeton University and the University of California, San Diego. One the main products of the COMPRES enterprise is its contribution to the peer-reviewed literature. COMPRES supported research in 274 publications in 2018-19. For the complete list see: http://compres.unm.edu/sites/default/files/publications/Publications2018-2019.pdf.

"Sandia/UNM Pulsed Power Extreme condition Research" (SUPER).
SUPER is a new collaboration between the Sandia National Laboratories (SNL) Pulsed Power Center and UNM (departments IOM/EPS and Electrical and Computer Engineering) that was established in 2018. The principal goals of the collaboration are threefold: 1) accelerate technical progress broadly in fields relevant to the National Nuclear Security Administration (NNSA), 2) cultivate a pipeline of experts in the fields of high energy density science and pulsed power, and 3) attract new graduate researchers to targeted STEM programs at UNM. Enhanced collaboration between UNM and Sandia will benefit both institutions. For example, there are natural parallels and connections between many research questions in geophysics and dynamic materials because both disciplines study matter in extreme conditions. The first step in forging this collaboration has now been realized by recruiting our first graduate fellowship recipient at UNM, Wade Mans. Wade has received this fellowship and started as a new grad student in EPS in Fall 2019. The fellowship will be fully funded by Sandia for 5-years and will include a stipend, travel and research support for pursuit of the Ph.D.

6D: Student Opportunities *Describe the opportunities for undergraduate and graduate students to be involved in research/creative works through curricular and extracurricular activities.*

Approximately 25-30% of our undergraduate majors participate in undergraduate research, with many completing senior theses. The Department is fortunate to have alumni support for undergraduate research through the Leonard Research Fellowships. Students who receive this fellowship are supported at $2000/semester for up to three semesters to conduct research. To receive these fellowships, students must work with a faculty mentor and submit a research proposal similar to the student proposals required by the Geological Society of America. We typically support 8-12 students with these fellowships each semester, though the numbers have been severely reduced due to the Covid pandemic.

All graduate students are engaged in research, as it is a core component of the MS and PhD programs. Students have opportunities to build a variety of research skills including field measurements for geology and environmental science, analytical geochemistry, GIS, computational geophysics, specimen-based paleobiology, and laboratory mineral physics. Student research is primarily funded through external grants to faculty. However, students are highly active in competing for supplemental funds from student scholarship and research grant programs at the university, state, and federal agency levels along with various geological societies. The laboratory facilities and faculty expertise in the Department attract collaborations with academic, federal agency, and private industry geoscientists across the U.S. and internationally. Therefore, students have exposure to a wide breadth of geoscience applications and can establish professional networks that are beneficial for career development. All recent PhD graduates have authored peer-reviewed paper, maps, or technical reports and more than half of our recent MS graduate publish similar creative works within three years of graduation. All recent PhD and more than 75% of recent MS students presented their research at major conferences each year.

EPS strongly values the opportunity for both undergraduate and graduate students to present their work and network with professional colleagues at a variety of society conferences including the Geological Society of America (both Annual Meetings and Regional Meetings), the American Geophysical Union, the Lunar and Planetary Science Conference, the spring and fall New Mexico Geological Society Meetings. Many graduate students have been funded to attend these conferences by faculty grants, some departmental resources including Alumni donations, and use of departmental vehicles. We have worked to send undergraduates doing senior thesis work to regional and national conferences using the same resources. In addition, the department has provided travel funding for some of our undergraduate students associated with the UNM American Indian Science and Engineering Society (AISES) to attend the AISES National Conferences (most recently in Milwaukee and Oklahoma City).

6E: Community Service *Describe faculty members' service to the UNM community and beyond (local, national, global). Examples include community engagement practices, volunteering on committees, professional organization membership/leadership, etc.*

Our faculty are highly engaged in community service from outreach activities, service to professional societies, organizing research workshops and conferences and leading multiple PI (national and international) research collaborations. All faculty are members of several professional societies including the Geological Society of America (GSA), the American Geophysical Union (AGU), New Mexico Geological Society (NMGS), and Incorporated Research Institutions for Seismology (IRIS). EPS faculty are involved with annual K-12 STEM events including the Central New Mexico Research Challenge, Science Olympiad, and Junior Science and Humanities Symposium. Dr. David Gutzler's outstanding record of Community Service was recognized in 2018 with the 4th Annual UNM Community-Engaged Research Lecture. Dr. Gutzler is an outstanding example of a researcher with strong community engagement including authorship of IPCC Chapters, work with State of NM legislators, tribal partners and many others on issues of climate change and water resources.

We have a very committed group of graduate students who are doing significant volunteer outreach work with the community including guest presentation at local middle and high schools, outreach to elementary school children and the general public at the STEM day at the New Mexico State Fair, and outreach here on the UNM campus (e.g. Welcome Back Days in August). Many faculty members take time to present guest lectures at local high schools, local organizations (New Mexicans for Science and Reason, Albuquerque Gem and Mineral Club, Rotary Club of Albuquerque) on issues including climate change, local geology, paleobiology and extinctions, and other aspects of our ongoing research.

Finally, we have facilities dedicated to outreach activities. This includes the Geology Museum and Meteorite Museum, both of which serve on average ~25 K-12 school groups per year, and the new Natural History Science Center, where part the building mission is to serve as a center for community engagement (e.g., in the form of public specimen displays, public lectures and events). The Geology Museum has recently received legislative support for substantial renovation to improve its outreach capacity moving forward.

Criterion 7. Peer Comparisons

The degree/certificate program(s) within the unit should be of sufficient quality compared to relevant peers. (If applicable, differentiate for each undergraduate and graduate degree and certificate program offered by the unit.)

7A: Analysis *Choose 3 peer departments from the Peer Comparison Template (Appendix E) to contrast with the unit. After completing the Template for these departments, provide an analysis of the comparison. Please describe aspects of your program that are unique compared to these peers.*

- *The unit may choose to select an alternative peer institution designated by a relevant regional, national, and/or professional agency.*

We have chosen three peer departments at the University of Arizona, Arizona State University and the University of Wyoming. All three have very strong Geoscience / Geophysics programs and are Carnegie Research 1 institutions.

The University of Arizona Department of Geosciences has one undergraduate B.S. degree with three sub-plans in Geology, Geophysics, and Earth, Oceans and Climate – each of which have different core classes and function effectively as tracks within the single degree. The department has approximately 220 undergraduates and 66 graduate students, roughly 2/3 in the PhD program and 1/3 in the MS program. Arizona has a large faculty supporting their degree programs – 34 tenure track members plus an additional 16 affiliated faculty members in other units (e.g. Lunar and Planetary Lab, Laboratory of Tree Ring Research, Hydrology and Atmospheric Sciences), making a large and diverse set of classes available for their students and allowing reduced teaching loads for more research. This is reflected in their US News and World Report Graduate Rankings in the Geosciences as 15th in the nation.

The University of Wyoming Department of Geology and Geophysics has three undergraduate degrees: a B.S. in Geology, a B.S. in Environmental Geology and Geohydrology, and a B.A. in Geology and Earth Science. There are approximately 150 undergraduates total divided among the three degrees. Wyoming has 27 MS students and 29 PhD students in their graduate program. Their program is supported by 22 faculty and 4 Research Professors/ Scientists. This department is very similar to EPS at UNM with similar undergraduate degrees, numbers of majors and graduate students and national ranking (both 46 in US News and World Report Graduate Rankings). However, they have 22 tenure track faculty vs. our 18 allowing for more flexibility in coverage of their courses.

The School of Earth and Space Exploration at Arizona State University is the largest by far of our comparisons and functions effectively as a separate college that includes the departments of Astronomy and Space Exploration, Astrobiology and Biogeosciences, and Engineering. The School has 7 undergraduate degrees, 5 certificate programs and 9 graduate degrees. Here, we consider those parts of the School most similar to our program: 2 degrees in geosciences (BA Earth & Environmental Studies, BS Earth and Space Exploration (Geological Sciences)), and 3 certificates including Field Geology, Geological Sciences, and Water Resources. Three graduate degrees include an MNS in Geological Sciences, an MS in Geological Sciences and a PhD in Geological Sciences. There is significant overlap in the broader curriculum between these undergraduate and graduate degrees and the other degrees offered by the School. There are 70 faculty in the School who span many of the degree program fields and many more research scientists. The School has a director (Dr. Meenakshi Wadhwa) and 5 associate directors.

The Department of Earth & Planetary Sciences at UNM compares favorably with these strong peer departments. Our degree programs have comparable breadth and depth to Arizona and Wyoming, and we note that ASU has one of the largest and most varied degree programs in the country in Earth and Space Sciences. Despite having similar degree programs to Arizona and Wyoming, we are trying to achieve the same goals with fewer faculty than those peers. Our graduate program is competitive with our peers both in terms of attracting top quality applicants, and in our student success (e.g. placing graduating Ph.D.s in faculty positions, M.S. students going on to Ph.D.s or on to good industry jobs). Our peer institutions are also making significant efforts to diversify their faculty and graduate programs. In terms of our research productivity and impact, we also compare favorably with our peers considering different state resources and support from the different university administrations. We are effectively tied with Wyoming in the U.S. News and National Report graduate rankings in the Geosciences (along with 3 other

schools) and both rank significantly higher than many universities in the Mountain West interior. Both the University of Arizona and Arizona State University are deservedly ranked very high nationally for their research impact. Where we excel here at UNM is the excellence of our faculty and graduate students, and with the support of the UNM administration, we have built a first-class set of research labs and facilities that are un-paralleled in other departments our size. These facilities in combination with our diversity in disciplines, ranging from high-pressure mineral physics and geophysics to geochemistry, field based approaches, climate science and remote sensing result in an environment that fosters collaboration leading to high productivity in creative works.

Criterion 8. Resources & Planning

The unit should demonstrate effective use of resources and institutional support to carry out its mission and achieve its goals.

8A: Budget *Provide an analysis of the unit's budget, including support received from the institution and external funding sources.*

- *Include a discussion of how alternative avenues (i.e., summer bridge programs, course fees, differential tuition, etc.) have been explored to generate additional revenue to maintain the quality of the unit's degree/certificate program(s) and courses.*

The funding available to support the Department's academic mission and activities comes from several sources: 1) State-apportioned university funds allocated to the Department by the College of Arts and Sciences, 2) cost-match funds for large equipment grants / purchases from the UNM Vice President for Research Office, 3) course fees charged to students when enrolling for specific classes, 4) external research grants and contracts awarded to faculty and research scientists by funding agencies, 5) F&A return from the UNM VPR and College offices, 6) several scholarship/fellowship funds managed by the UNM Foundation and dispersed to the Department quarterly or annually into spending accounts, 7) analytical laboratory operating accounts that charge set fees for services, 8) the Caswell Silver Foundation, a non-profit foundation (independent of the UNM Foundation) established in 1980 by the Silver Family to provide several types of support to the Department. The Institute of Meteoritics has its own budget and is excluded from this analysis.

Department Annual State-Funded Budget

The institutional I&G budget is the primary source of funding that supports the instructional mission of the department. Most of these funds are for faculty, staff, and graduate students (TA/GA) salaries, accounting for about 96-97% of the total I&G budget (Figure 2). The salary budget increased from 2013 to 2016 following mandated state employee salary increases and the negotiated general salary increases following the last APR and the recommendation of the review team. Following 2016, retirements and separations have resulted in a relatively flat salary line, despite new hires coming on board during this time. The department operating budget has remained steady at an average of $75K/year, although the College of Arts and Sciences was

forced to apply a permanent cut to departmental operating budgets of 10% in January 2021. This budget includes normal operating expenses such as teaching supplies, photocopier, computers for our teaching labs, software including GIS licenses and other specialty software, faculty travel (although most faculty travel expenses are covered by individual grants and contracts), maintenance of our field vehicles and other sundry expenses. This part of the departmental budget also saw a significant rescission in 2012 (~44% cut) that was addressed by cutting phone lines, computer purchases, travel, and travel for outside speakers (our weekly 401/501 lectures). The department then and now relies more on unrestricted UNM Foundation funds to purchase essential equipment for teaching (e.g. new petrographic microscopes, projection equipment in Northrop Hall, computers, field vehicles) and for outside lecturers. The Department is fortunate to have a level of foundation funds that helps mitigate declines in the quality of instruction when new budget challenges suddenly arise. However, the long-term intent of our donors is to build upon the quality of instruction and student support provided by State I&G funds rather than replace it. For instance, the department could further enhance field experiences or research opportunities for students rather than purchase basic classroom equipment with donated funds.

One aspect of the EPS budget that often receives attention in comparison with other departments in the College of Arts and Sciences is the significant fraction of the department's I&G budget which goes towards staff salaries. In AY19-20 for example, these salaries constituted 22% of the department I&G budget. This large budget component devoted to staff salaries has arisen because we have nine staff members (see section 8B), partially to fully supported by state funds, who play key roles in the management and running of our major analytical facilities, as well as a research engineer. It is worth noting that our research engineer, Chris Anderson, excels with all our instruments, so several labs have been able to save hundreds of thousands of dollars or more in equipment maintenance contracts. Prior to 2013, we also had a departmental network manager, but this position was reclaimed by the College of Arts and Sciences in a budget saving initiative. New computational research support (0.5 FTE, Mr. Ben Archuleta) was promised to the department in support of our Geophysics Group (now 3 faculty, 2 postdocs and several graduate students) as part of a retention offer to Dr. Brandon Schmandt in 2015 and reaffirmed as part of a hiring offer to Dr. Eric Lindsey in 2020. However, this position is not supervised by the Department and the College cuts back or temporarily eliminates support without consultation. As of 2020, Mr. Archuleta only works for UNM at 0.25 FTE and very little of that time is allocated to the Department. The scarcity and unreliability of research IT support severely impact research productivity and student success in the Geophysics program and scientific computing capabilities in the Department as a whole.

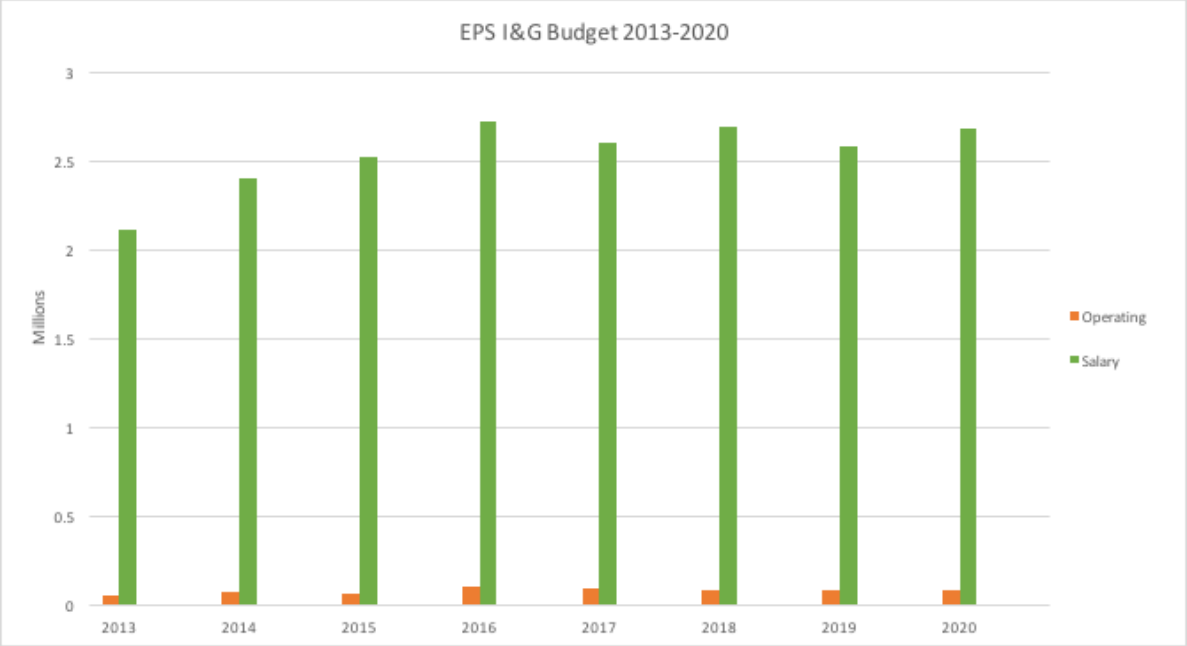

Figure 8. EPS I&G Budget including total salary lines and operating budget with faculty travel

These staff members play a critical role in the instructional and research mission and goals of not only the Department, but also the College of Arts and Sciences and University in general. The College and University has generously acknowledged and recognized the important contribution of these individuals to the overall success of the University by maintaining and in some cases increasing I&G funding of a larger number of such Department personnel over the past forty years. Without these I&G supported positions, it would be impossible to maintain the sophisticated multiuser analytical laboratories that we have developed in the Department. These staff members not only play an essential role in maintaining the expensive analytical instruments and in research, but also make major and invaluable contributions to teaching and mentorship of both undergraduate and graduate students who are engaged in research. In some cases, these individuals teach formal courses in specific instrumental techniques (e.g. electron microscopy, X-ray diffraction), but most importantly they provide hands on instruction in the laboratories for a very large number of undergraduate and graduate students, both from within Earth and Planetary Sciences and from across the UNM campus. Many of our laboratories are multiuser facilities that serve the UNM campus community and provide analytical capabilities to hundreds of users each year. These users come from within the College of Arts and Sciences (Anthropology, Chemistry and Chemical Biology, Biology, EPS, Physics and Astronomy), the School of Engineering (Chemical and Nuclear Engineering, Civil Engineering, Mechanical Engineering, Center for High Technology Materials) and the Health Sciences Center (e.g. School of Pharmacy). Our research staff provides essential training on the instruments for these users, assistance with data acquisition and interpretation, and oversee laboratory safety, quality control and instrument maintenance and upgrades. It is also critical to note that many of these research staff hold PhDs and are active in obtaining external grants and contracts, that generate substantial F&A return for the University.

At the time of the last APR in 2013, the Department had two Lecturers, Dr. Aurora Pun who has focused on pedagogy and the introductory Geoscience classes and labs, and Dr. Mel Strong who ran the Natural Sciences Program for College of Education students. With the closure of the Natural Sciences Program in 2015, Dr. Strong taught classes in the department for a year, then left UNM for a position in Los Alamos. That full lecturer position was not replaced. Unlike many departments, we do not rely significantly on Part Time Instruction (PTI) funding to deliver our curriculum (typically one to two sections per semester). Since the last APR, this relatively small allocation has declined further. In the last year, we have had several faculty taking sabbatical leaves, so we negotiated PTI funding from the College leveraging funds from the Caswell Silver Foundation for graduate instruction (roughly 50:50 split) to deliver classes that the tenure-track faculty do not teach (e.g. in Fall 2020, Soils Geomorphology was taught by Emeritus Professor Les McFadden, and Drones and Robots was taught by Adjunct Professor Scott Nowicki).

Non-State Funding

The faculty and research staff in EPS submit many research proposals for contracts and grants to a wide range of external funding agencies. These funds support research activities, analytical labs, graduate student stipends as well as conference travel. This funding is also a significant component the salaries of many of the Research Scientists associated with our analytical laboratories. These funds augment the Department's state-supported budget in many ways. For example, the Department receives back a portion of the overhead (F&A) generated by faculty and research staff each year. This amount varies depending how much overhead is returned to the College by the Office of the Vice President for Research (OVPR) – in the last 5 years this was reduced – and it depends on the College return to the Department. In 2019, the College reduced the return to departments from a 60:40 split to an 80:20 split in response to budget reductions. At the same time, the College also changed the ratio of funding for new faculty start-up packages in the same way (from 60:40 to 80:20). As the department primarily uses F&A return to fund its commitment to new faculty startup packages, this change has not impacted us in a significant fashion. The same is not true of the Institute of Meteoritics which relies almost entirely on F&A return to fund its day-to-day operations. In fall 2020, Dean Mark Peceny requested that EPS pre-pay its startup promise early for our two new faculty members (Mackey and Lindsey) (rather than pay year by year for 3 years, EPS funded the entirety of our startup commitments in year 1 saving F&A in the current fiscal year for other College use). As a result, our F&A balance decreased to almost 0. However, given recent success in external contracts and grants, this F&A balance will increase over the next 3 years allowing us to save for a new faculty hire and startup package. Table 12 shows the total F&A generated by EPS (by itself), the CSI and the IOM over the last 8 years. Both EPS and IOM have been relatively consistent from year to year, even though the total number of active faculty members in the department has fallen from 2013. Note the tremendous growth in F&A generated by CSI since 2014.

Table 12. Total F&A Generated over the last 8 years by EPS, CSI and the IOM. Each entity receives back a fraction of the total generated depending on the rate of return from the OVPR Office to the College, and the rate of return from the College to Departments. These rates have varied over the last 5 years.

Years	EPS	CSI	IOM
2013	$623,008.52		$435,059.91
2014	$602,141.28	$6,800.44	$497,345.95
2015	$487,578.13	$31,318.22	$442,396.43
2016	$443,137.25	$42,806.63	$485,913.78
2017	$530,600.74	$78,700.77	$541,270.80
2018	$596,354.60	$73,358.16	$554,561.23
2019	$508,969.46	$30,080.90	$425,369.69
2020	$556,672.96	$91,204.03	$423,253.50

Alumni Endowments - UNM Foundation: The other main sources of non-state funding are those associated with various endowments established by alumni and friends of the department over the past few decades as well as funds made available to the department by the Caswell Silver Foundation. With respect to the former, departmental endowed funds account for over 12% of the total endowments available in the College with an estimated Fair Market Value of the Fund Principals of over $6 million (UNM Foundation) and over $8.5 million (UNMF and Caswell Silver Foundation). Many of these endowments, held and managed by the University of New Mexico Foundation, are expressly for undergraduate and/or graduate student scholarships. Some of these are for specific disciplinary areas (e.g., mineralogy, paleontology, energy and resources, geomorphology) and some broadly intended for EPS and ENVS students. Each year, these endowments provide over $50,000 for scholarships, weighted more towards graduate student scholarships but still providing substantial undergraduate scholarship opportunities.

The Caswell Silver Foundation (CSF) is the largest single source of departmental funds from endowments. Established as a non-profit foundation by alumnus Caswell Silver in 1980, the sole purpose of the CSF is to support the academic mission of the department, especially as it pertains to graduate education. The CSF is independent of the UNM Foundation with a separate board made up of departmental alumni and the corpus is managed by the Horizon Group at Morgan Stanley who make investment recommendations to the board and disburse the proceedings to the department. The CSF funds provided annually to the department over the last 40 years have supported many different activities. These include annual support for two graduate fellowships called the Kelley-Silver fellowship, with a competitive stipend, tuition and health care support, and $3,000 for annual research expenses or travel. Periodic funding of the salary and expenses of a Caswell Silver Visiting Professor – this was negotiated with Dean Peceny to help support salary and we were able to bring in several visiting professors over the last 6 years to teach a specialized graduate class and work with graduate students. In 2019, following an increase in earnings that would allow two full graduate fellowships to be funded, the board decided to postpone future visiting professors and focus on providing the two graduate K-S fellowships. The fund also provides for two annual Caswell-Silver staff awards of $1,000 for our excellent, hard-working front office and research staff. In the past, the fund has supported faculty travel, an

undergraduate research symposium, equipment and computers, and additional graduate student support.

Over the last 10-15 years, the department has been the beneficiary of several large (and smaller) alumni gifts allowing us to expand our support of teaching, research and student scholarships. Of special note is the Harry and Mabel Leonard Scholarship Fund in Earth and Planetary Sciences. This fund is used to support undergraduate students conducting research in the department. Each semester, the department solicits applications for funding ($2,000 per semester, renewable for up to 3 semesters) where undergraduate students develop a short research project proposal with one of our faculty members and these are evaluated by the Undergraduate Committee. Students often go on to write a senior thesis based on this work but it is not required – the main purpose is to expose undergraduate students to research and our research facilities. Students are asked to present a short summary of their work at a research symposium, usually in April. We have also expanded this program to include Leonard Teaching Fellows (the same $2,000 per semester) where students work with a faculty member to develop new teaching materials for a class. Prior to the pandemic, we were supporting as many as 8 students per semester and we anticipate post-pandemic the same number of students will continue to participate.

Other important endowments include the Albert and Mary Jane Black Professorship in Hydrology, which is currently held by Dr. Gary Weissmann. This fund is not a fully endowed professorship but it pays a substantial part of the salary. Alumnus Bill Lovejoy recently endowed the "Stuart A. Northrop Distinguished Lecture Series" allowing us to bring in a prominent scientist each year for a lecture and reception – both made available to the wider university community. We also advertise this series with our alumni base and many have attended these lectures making this a popular alumni outreach opportunity. The lecture series started in 2017 with Dr. Jonathan Payne (Stanford University), followed by Dr. Susannah Porter (UC Santa Barbara) in 2018 and Dr. Meenakshi Wadhwa (ASU) in 2019. In 2020, we had invited Dr. Maureen Raymo, but had to cancel the lecture due to the COVID pandemic. Dr. Raymo will conduct the lecture this spring remotely. In the absence of a lecture this past year, Dr. Lovejoy agreed to allow the funds for 2020 to be used for graduate student support, and in fact, he made a second donation in 2020 to support graduate student scholarships in paleobiology and sedimentary geology.

Our largest UNM Foundation fund at present is the Ernest I. Rich and Mary Catherine Rich Fund for Geology. Dr. Rich was an alumnus of the department and a long-serving faculty member at Stanford University. Based on his experience as a faculty member, he decided to make his gift unrestricted, allowing the department significant flexibility in how to use the income. To date, we have used the fund in negotiations with Dean Peceny to accelerate faculty hires in the department by providing funds for startup packages for our two most recent hires. With the reduction of two TA lines as of January 2021, the department decided to dedicate funds for the next two years to provide graduate student support to keep our graduate student numbers at the same level. This fund has also provided small amounts of seed money to faculty members for new projects or to pay page charges, meeting registration, etc. We have also used it to send undergraduates who did research to regional and national meetings including GSA (Indianapolis, Phoenix) and AGU (San Francisco) so they could present their work and meet with prospective graduate school mentors. The Frank D. Gorham and Marie Kelly Gorham Charitable Foundation

Endowment for Geoscience Education also allows flexibility in its use, although with preferred categories. To date, we have used this fund to purchase 10 new petrographic teaching microscopes to upgrade our undergraduate petrology and mineralogy classes, to support the purchase of new field vehicles used for class field trips and our summer capstone field class, to support extended class field trips to places like the Grand Canyon and Permian Reef national parks (including bus or departmental field vehicle rentals), and graduate and undergraduate scholarships. In 2019, the faculty decided to pool several smaller endowed graduate scholarships to allow for a full month of summer support for incoming graduate students supported on TAs (one month for incoming MS students and two months over two years for incoming PhD students). In the past, we distributed these funds to all graduate students, but we think the new, more targeted distribution process will give us a competitive advantage in recruiting new graduate students as many other (but not all) institutions are offering incoming graduate students a "signing bonus".

The generosity of our alumni is both heartwarming and is critical to maintain our excellence in teaching, attracting top graduate students, and research, particularly in these times of reduced state and university resources. The department continues to effectively conduct alumni outreach and work with UNM Foundation to bring in new funding to support our programs. Just this past year, we have received several new endowments including the aforementioned Bill Lovejoy graduate scholarship and an endowment honoring former faculty member, "Kase" Klein with a scholarship in mineralogy by his wife, Shirley Morrison.

8B: Staff *Discuss the unit staff and their responsibilities (including titles and FTE). Include an overall analysis of the adequacy and effectiveness of the staff composition in supporting the mission and vision of the unit.*

The department has four Administrative Staff members who support both the teaching and research mission as well as service, though as of the end of January one of these staff members is retiring. We also have many technical staff members, several at the PhD level to support our many analytical facilities (described below). One of our most successful facilities, the TEM/SEM lab, has lost two PhD level technical staff in the last 6 months and with the UNM budget crisis, we have not yet been allowed to replace these positions causing a significant shortfall in the ability of this lab to conduct research, train graduate students and other users, and indeed write new grants and contracts to support the research mission of the lab. The two staff members, Elena Dobrica (left in August for a tenure track faculty position at the University of Hawaii) and Ying-Bing Jiang (left in September for the private sector in California) are essential for the smooth operation of the lab overseen by PI Dr. Adrian Brearley. With the new 2.5 million dollar TEM instrument recently funded by NSF, and an additional 1-million-dollar additional facility grant from NASA, there is an opportunity to hire at least one world class technical scientist who would raise additional grant money to support their own salary (and raise significant F&A revenue for the university). As of January 2021, we have been approved to search for a replacement for Dr. Jiang, using funds from the Dean's discretionary fund, CMEM and from the department with this position to transition to I&G in a year's time. Unlike nearly all Earth science departments at peer institutions, we do not have dedicated scientific computing or research IT staff. This creates significant burden on faculty who must rely on limited, non-

specialist staff at the college level for systems administration, database management and hardware and software trouble-shooting.

Administrative Staff

Paula Pascetti - Department Administrator (DA). Reports directly to the Department chair. Ms. Pascetti manages the Department office, including supervising Cecilia Arias, Mabel Chavez and departmental work studies in the Department office. She is responsible for multiple aspects of the administration of the Department. Her duties include: all hiring activities for student employees, postdoctoral fellows, staff, part time instructors, faculty search coordination, management of mid-probationary reviews, as well as tenure and promotion reviews, class scheduling, departmental inventory, purchasing of major items (computers, major equipment, vehicles, etc.), handling of departmental scholarships, coordination of departmental field camps, coordination of major departmental events (convocation, special seminars). The DA Works closely with the departmental account and the department chair to make budgetary decisions for the Department. In the absence of a Department Facilities Manager our DA has taken on significant responsibilities for oversight of the Department infrastructure.

Cecilia Arias: Administrative Assistant. Serves as the Department graduate program coordinator; manages the graduate program admissions process; keeps student records; provides advisement on Office of Graduate Studies requirements, record keeping, and reporting; provides clerical support to the entire Department faculty; and provides front office / reception for the Department, as required. Provides additional support for annual inventory and departmental events (commencement, special receptions, seminars, graduate orientation workshops). Ms. Arias reports to Paula Pascetti. Reports building infrastructure problems to Physical Plant.

Mabel Chavez: Technical Assistant. Provides clerical support to the chair as needed and alumni records. Oversees departmental field vehicles, including routine maintenance, repairs, insurance, etc. Organizes and handles reimbursement and ordering supplies as needed for student, faculty and staff teaching and research activities. Ms. Chavez retired on Jan 31, 2021.

Faith Mutchnik: Accountant III Ms. Mutchnik reports directly to the Department chair. Her responsibilities include: Monitoring the business activities of the Department through the maintenance and control of financial records including restricted and unrestricted accounts, as well as endowments. Performing advanced accounting functions in the management of the Department fiscal activities; prepares integrated financial and statistical reports, statements, projections, and recommendations that may have long-term impact on funding for the organization. Included in the responsibilities is the processing of a high volume of purchasing and reimbursement documents, journal entries, reconciliations, payroll, reports, and special projects. Ms. Mutchnik has also taken on additional responsibilities with the Center for Stable Isotopes (CSI).

Maggie Sumruld: Senior Academic Advisor - College of Arts and Sciences Ms. Sumruld is our in-house College undergraduate advisor. She meets regularly with EPS and ENVS students to check in on degree progress, math and science pre-requisites, and provides advice on electives

and other academic issues. She is also the advisor for Physics and Astronomy, and Geography and Environmental Sciences.

Research and Technical Staff

The Department has several technical staff members who have responsibilities relating to managing and supporting the extensive laboratory facilities that the Department maintains. These individuals are supported by a variety of funding sources, including I&G funding from the College of Arts and Sciences, departmental F&A funds, revenues generated from operation of the laboratories as well as grants and contracts.

Dr. Abdulmehdi Ali: Senior Research Scientist I. Dr. Ali holds a 0.8 FTE position as manager and supervisor of the Analytical Geochemistry Laboratory in the Department. The position is funded by I&G funds (0.67 FTE) and by revenues generated by the laboratory (0.13 FTE). Dr Ali reports directly to the Chair of the Department. The laboratory is a multiuser facility that provides analytical chemistry services to the Department of Earth and Planetary Sciences and many other departments on campus from the College of Arts and Sciences, School of Engineering and the UNM Health Sciences Center. Dr. Ali is responsible for all aspects of the operation of the laboratory including the operation, maintenance, repair and troubleshooting of laboratory instruments, development of analytical procedures, training of users of the laboratory in analytical techniques and chemical safety, quality control of analytical data. He is also responsible for the long-term strategic development of the facility in consultation with faculty to meet future analytical needs of the Department. Although the Department has no formal expectation of teaching from Dr. Ali, he contributes in significant ways to both formal and informal instruction. He team teaches a Spring class (CE 437/537), Aqueous Equilibrium, Chemistry, and Analysis, and summer Water Resources Program class (WR 573). He has also taught our ENVS capstone course (ENVS 430L). He also contributes significant time and energy to assisting students carrying out laboratory tasks in classes taught by other faculty such as the field-based class Advanced Environmental Sciences and the Instrumental Techniques in Geochemistry class. He serves as a member on M.S. and Ph.D. student thesis committees as requested. Dr. Ali has served as PI and Co-I on several grant proposals providing extramurally-funded instrumentation housed in the Analytical Laboratory.

Dr. Viorel Atudorei: Research Scientist III. Dr. Atudorei holds a 1.0 FTE position in the Department as manager of the Center for Stable Isotopes (CSI). Dr. Atudorei reports directly to the director of the facility, Distinguished Professor Zachary Sharp. Dr. Atudorei is funded at a 0.92 FTE by I&G funds and 0.08 FTE by revenues generated by the laboratory. The laboratory is a multiuser facility that provides stable isotope analytical capabilities to the Department of Earth and Planetary Sciences and many other departments on. Dr. Atudorei is responsible for all aspects of the management of the laboratory including the operation, maintenance, repair and troubleshooting of laboratory instruments, development of analytical procedures, training of users of the laboratory in stable isotope techniques, laboratory chemical safety and quality control of analytical data. Dr. Atudorei also collaborates on research projects with members of the Department faculty as requested.

David Griego: Harding Mine caretaker. Mr. Griego is the caretaker of the Harding Pegmatite Mine in Dixon, New Mexico and was hired in this position last year following the retirement of long-serving caretaker, Mr. Gilbert Griego. He holds a 1.0 FTE I&G funded position. His duties include oversight of all aspects of the mine, particularly safety, necessary maintenance of facilities, leading University and school parties on tours of the mine, handling paperwork (liability forms, etc.) associated with all visitors (individuals and groups). Mr. Griego has also overseen significant renovations to the mine as part of the New Mexico Bureau of Mines efforts to improve the safety of old mine workings in New Mexico and provided much needed advice and recommendations to the engineers in charge of the project.

Dr. Eric Peterson: Sr. Research Scientist II. Dr. Peterson is a materials scientist by training, but also has an undergraduate degree (BS) in Earth Sciences from UNM. He is manager of the X-ray diffraction laboratories. He holds a 0.75 FTE position funded at a 0.25 FTE level by I&G funds from the College of Arts and Sciences, 0.25 FTE funded by the UNM Center for Microengineered Materials (CMEM) and 0.25 FTE from research grants and revenue from the laboratories. Dr. Peterspn is responsible for all aspects of the management of the laboratory including the operation, maintenance, repair and troubleshooting of laboratory instruments, development of analytical techniques, preparing documentation of laboratory protocols and techniques, training of users of the laboratory in analysis techniques, assisting users within interpretation of data, laboratory chemical safety and quality control of analytical data. Dr. Peterson also contributes significantly to teaching in the Department as instructor for the graduate level class X-ray Diffraction (EPS 425) each Spring semester.

Chris Anderson: Research Engineer II. Mr. Anderson has a 1.0 FTE position in the Department funded by I&G funds (0.88 FTE) and a combination of F&A and support from several analytical laboratories that he works with (0.12 FTE). Mr. Anderson provides electronic, electrical and high vacuum technical expertise to troubleshoot and repair a wide range of sophisticated analytical instruments in the department. Mr. Anderson's expertise on a wide variety of electronics and instrumentation has saved PIs in the department tens of thousands of dollars in maintenance contracts over the years. Anderson also provides advice regarding upgrades and renovations to the building that impact our analytical facilities.

Dr. Victor Polyak: Sr. Research Scientist I. Dr. Polyak has a 1.0 FTE position in the Department as manager of the Radiogenic Isotope Laboratory. Dr. Polyak reports directly to the director of the facility, Professor Yemane Asmerom. Dr Polyak is funded at a 1.0 FTE by I&G funds. The laboratory provides elemental and radiogenic isotope analytical capabilities to the Department of Earth and Planetary Sciences and other departments on campus. Dr. Polyak is responsible for all aspects of the management of the laboratory including the operation, maintenance, repair and troubleshooting of laboratory instruments, development of analytical procedures, training of users of the laboratory in analysis techniques, laboratory chemical safety and quality control of analytical data. Dr. Polyak also carries out his own NSF-funded research using speleothems as proxies of past climatic change.

Michael Spilde: Sr. Research Scientist I. Mr. Spilde has a 1.0 FTE position in the IOM as manager of the microbeam facilities and is also engaged in teaching and mentoring activities and carries out his own NSF-funded research with an emphasis on mineral chemistry and

biomineralization- particularly in association with microbiological processes in extreme environments.

Dr. Elena Dobriča: Research Scientist I. Dr. Dobriča holds a 1.0 FTE position (0.5 FTE from I&G funds and 0.5 from lab revenues) as assistant manager of the Transmission Electron Microscopy and Focused Ion Beam/Field Emission Gun SEM laboratories. She supports the manager of the laboratory, Dr. Ying-Bing Jiang and reports through Dr. Jiang to the Director of the laboratories, Professor Adrian Brearley. She is responsible for the day to day operation of the laboratory, duties that include training new users on the instruments, assisting users with the operation of the instruments, ordering supplies for the laboratory, trouble-shooting technical problems with the instrumentation, maintaining laboratory computers (upgrades, backing up data, etc.) and laboratory cleanliness. She also carries out analytical work for researchers on the instruments as requested, prepares samples and works on research projects with other faculty members are requested. Dr. Dobriča left UNM for a tenure track faculty position at the University of Hawaii in June, 2020.

Dr. Ying-Bing Jiang: Sr. Research Scientist II. Dr. Jiang is a materials scientist by training and is manager of the Transmission Electron Microscopy and Focused Ion Beam/Field Emission Gun SEM laboratories. He holds a 1.0 FTE position funded at a 0.66 FTE level by I&G funds and 0.34 FTE by research grants and revenue from the laboratories. Dr. Jiang is responsible for all aspects of the management of the laboratory including the operation, maintenance, repair and troubleshooting of laboratory instruments, development of analytical techniques, preparing documentation of laboratory protocols and techniques, training of users of the laboratory in analysis techniques, assisting users within interpretation of data, laboratory chemical safety and quality control of analytical data. He also carries out independent research funded by his own research grants and contracts and in collaboration with faculty. Dr. Jiang also teaches the Department's graduate level class in Analytical Electron Microscopy (EPS 538L) each Spring semester. Dr. Jiang left UNM in September, 2020 for a position in private industry.

8C: Advisory Board *If the unit has an advisory board, describe the membership, their charge, and discuss how the board's recommendations are incorporated into decision-making.*

The Caswell Silver Board, an external foundation that supports departmental activities, consists exclusively of EPS alumni, the department chair (Fawcett) and one additional faculty member (Worthington). The board meets twice a year, and disburses funds from its corpus and earnings (3.5% of the corpus per IRS rules) to support graduate student activities. At each meeting, the board is informed of recent departmental activities and makes suggestions as to how they can support these with the proceeds. Currently, the Foundation is supporting two Kelley-Silver Graduate Fellows recognizing the importance of keeping a strong graduate program in the face of declining University resources.

Criterion 9. Facilities

The unit facilities should be adequately utilized to support student learning, as well as scholarly/research activities.

9A: Current Space *Provide an updated listing from UNM's current space management system of the spaces assigned to your unit (e.g., offices, conference rooms, classrooms, laboratories, computing facilities, research space, etc.). Discuss the unit's ability to meet academic requirements with current facilities.*

- *Explain if the unit has any spaces that are not documented in UNM's space management system.*
- *Explain the unit's unmet facility needs.*
- *If applicable, describe the facility issues that were raised or noted in the last APR. What were the results, if any?*

The Department of Earth and Planetary Sciences and the Institute of Meteoritics occupy a 4-floor building (Northrop Hall), constructed in 1953, with minor additions since then. Since the last APR, EPS has expanded its space footprint outside of Northrop Hall with several labs moving over to the Physics, Astronomy and Interdisciplinary Science (PAIS) building. These include the Center for Stable Isotopes (CSI), the TEM Facility and the XRD Facility. The new NHSC (tentative opening in late 2021) will house vertebrate and invertebrate fossil collections, and serve as a research and teaching space for paleobiology. Otherwise, Northrop Hall houses all offices for faculty, staff, graduate students and visiting scientists, in addition to the departmental laboratories and classrooms. The Institute of Meteoritics is also housed in Northrop Hall and there exists an excellent synergy between EPS and IOM in terms of teaching, research, and laboratory facilities and collections. The IOM is a vital and important contributor to our research and teaching enterprise and contributes tremendously to the recognition of UNM as one of the premier institutions to study planetary materials, and is highlighted individually. Descriptions of the main EPS infrastructure (classroom space, analytical facilities) complete this section.

Institute of Meteoritics (IOM)

Founded at UNM in 1944, the Institute of Meteoritics was one of the first institutions in the world devoted to the study of meteorites and has over the past 77 years earned a reputation as a premier center for research on planetary materials, featuring a unique collection of over 900 meteorites, most of which are extremely rare, including samples from Mars, the Moon, and many unusual asteroids. In 2019 we celebrated the 75th anniversary of IOM with an evening of keynote talks followed by a day-long symposium with guest speakers highlighting advances in meteorite research. In 2016 we finished a complete renovation of the UNM Meteorite Museum thanks to support from the New Mexico state legislature and UNM Provost's Office. Currently, we have several major research initiatives funded by NASA and NSF to study meteorites, planetary formation, moons, asteroids, and comets. To support these studies, IOM features laboratories with the state-of-the-art analytical and experimental capabilities. Staff and students are also science participants in NASA's missions of exploration, leading robotic reconnaissance of Mars, and planning future missions to the Moon and other destinations in our solar system. Every year, IOM research is published in numerous major national and international journals, and is presented at national and international conferences**.** Mentoring, teaching, training, and extensive involvement of graduate and undergraduate students in original research projects stand as primary goals of the IOM. The IOM's main source of external support since 2015 has been the NSF cooperative agreement "Consortium for Materials Properties Research in Earth Science (COMPRES)". We also are participating in a major new NASA initiative "Apollo Next

Generation Sample Analysis Program (ANGSA)" led by Charles Shearer, which has as its goal to examine yet untouched lunar rocks in sealed drive tubes sampled from the Moon's crust and brought back to Earth by the astronauts in the Apollo 17 Mission.

History of the Institute

In 1941, Dr. Frederick C. Leonard published a short paper in *Contributions of the Society for Research on Meteorites* entitled "The need for an institution for research on meteorites". He pointed out the almost complete neglect of scientific studies of meteorites and meteors, despite the fact that they are "the only tangible objects of astronomical inquiry", and suggested that the field of meteoritics was greatly in need of an institution dedicated to research in these fields. The University of New Mexico responded to this plea by founding the Institute of Meteoritics. The first director of the Institute was Dr. Lincoln LaPaz, who was also Head of the Department of Mathematics and Astronomy at UNM. Over the past six decades there have been a total of five IOM Directors: Dr. Lincoln LaPaz (1944-1966), Dr. James Wray (1966-1967), Dr. Klaus Keil (1967-1990), Dr. James Papike (1990-2002), Dr. Carl Agee (2002- present).

The original objectives of the Institute were to promote the recovery, exhibition and scientific study of meteorites, the advancement of pure sciences such as the study of meteors, and practical applications of such knowledge. LaPaz established world-class meteorite collection which is still being developed and enhanced, and which has been used extensively for research and education throughout the history of the Institute. In the mid-1960s, in anticipation of LaPaz's retirement, a decision was made by President Popejoy to align the IOM more closely with the Department of Geology (now Earth and Planetary Sciences), rather than the newly formed Physics and Astronomy Department, thus the meteorite collection was moved to Northrop Hall at that time. In 1974, a new Meteorite Museum was opened in Northrop, and the exhibit features many spectacular specimens from the Institute collection, and is visited by thousands of people each year. Dr. Klaus Keil was appointed as director in 1967, and a short time later he received UNM's first research grant from National Aeronautics and Space Administration (NASA) to study the Moon rocks brought back to Earth by the Apollo 11 astronauts. Since that time the IOM has enjoyed uninterrupted funding by NASA for studies of lunar samples, meteorites, and wide range of topics in planetary science. The IOM has grown from what was LaPaz's "one-man-show" with a meteorite collection, at the close of World War II, to its current status as a dynamic research and teaching institute, employing a total of twenty-five scientists, post-docs, graduate students, undergraduate students, and administrative assistants.

Management

The IOM Director reports to the Dean of the College of Arts and Sciences, and oversees the IOM research, teaching, and budget. The IOM offices and laboratories are located in Northrop Hall on the UNM Main Campus. IDC return funds from our numerous external grants from NASA and NSF are used to maintain the IOM office, which provides our scientific staff assistance for grant submission, Banner accounting, travel, and provides supplies and services for IOM offices and labs. F&A-return is our sole source of recurring funds that is not tied directly to a research grant -- though of course this "returned" F&A is self-generated and dependent on having grant money to spend in the first place. I&G from the Colleges of Arts and Sciences provides partial salaries for the research staff. The lion's share of the IOM "operating costs" comes from our external grants. These costs include maintenance and unplanned repairs for our laboratory equipment;

materials, supplies, and archival tools and infrastructure for curating the Meteorite Museum collection; for computers and computer supplies used by IOM staff, graduate students, and faculty.

Even though IOM is generating record levels of F&A from overhead-encumbered external grant expenditures we have seen a drastic reduction in F&A funds flowing back to us from the College of Arts and Sciences. This reduction was imposed in 2018 and since has effectively cut our operating budget to about 1/3 of what it has been historically (at least since 2002). The IOM laboratories, the UNM Meteorite Museum, and the COMPRES Central Office do not receive I&G funds for operations. Our I&G "operations budget" was deleted during the University-wide budget cuts of FY2008. As mentioned above, all our operational costs, not covered or permitted in our federal grant budgets, are paid completely from our return on F&A. As a result of the cuts to our F&A return, we are experiencing a significant negative impact on our operations.

IOM Student Training and Mentoring
Our graduate students are probably the highest priority in the IOM, and we have made it a policy to support our students whenever possible, to travel to scientific meetings, to provide them with desktop computers, and high quality office space. We pride ourselves on the delivery of high level, one-on-one, research interaction to our graduate students. We have a strong track record in recruiting and hiring undergraduate students to work, gain experience, and carry out their own projects in IOM facilities, mentored by our scientific staff. Currently we employ six UNM undergraduates in the IOM. Naturally, our students have total access to IOM labs and facilities for their research projects and thesis work.

EPS Classroom and Program Space

As the department has grown over the past 30 years, particularly in the expansion of its analytical laboratory facilities, classroom space in Northrop Hall has come under increasing pressure. As a consequence, some of our classroom space has been reutilized for research laboratories and the teaching activities moved to new classroom facilities outside the Department. Nevertheless, the Department considers it to be essential that classroom and teaching laboratory space that is used for instruction for our majors remain within Northrop Hall, so that our students spend a significant amount of time within their home department. This allows them to establish closer links with faculty, staff and graduate students as well as their peers. We have therefore made considerable efforts to maintain and improve our core teaching classrooms in Northrop Hall. Important renovations to our instructional space within the Department were completed following the last APR in 2013.

The text below summarizes the last 15 years of developments related to teaching and instructional space in Northrop Hall. Despite these renovations, a 2021 survey of EPS graduate students ranks the meeting and collaborative space in our department only at 2.8 (1=inadequate and 5=excellent). Most students state that insufficient collaborative and meeting space is available and that space has outdated furniture and inadequate cooling.

Issues of outdated appearance, such as paint, flooring, and tiles have been raised in the survey of faculty, research staff and students regarding collaborative spaces, hallways, and bathroom

facilities. Faculty and students also cited issues of heating and cooling, dust and ventilation for their office spaces. Northrop Hall was constructed in 1953 and while many phases of renovations have occurred, as outlined below, most of these were done in a piecemeal fashion, focused on specific laboratories and classrooms, delayed by lack of funding and without an emphasis on making the overall work environment in the building more modern and on par with our high-level of research and scholarly activities.

A brief history of developments relating to instructional space within the Department over the last 15 years is provided here to provide context. The major catalysts for the changes in utilization of classroom space that the Department has experienced have been driven by: a) the conception and realization of a new collaborative learning science building, the Science and Math Learning Center (SMLC) which was opened in January 2010 on the UNM campus, and b) the demand for additional research laboratory space in Northrop Hall, both from the Department and from the Institute of Meteoritics which has progressively reutilized teaching classroom space in the building.

The Science and Math Learning Center (SMLC) includes the Department of Mathematics and Statistics, freshman Chemistry teaching laboratories, some Biology laboratories, and one large lecture hall and several computer-based classrooms. The Department of Earth and Planetary Sciences was designated approximately 5,000 square feet of space in the basement of this new building for the Natural Sciences Program laboratory/ classroom, office space for the Natural Sciences Program, a laboratory/classroom for the EPS 105L Physical Geology lab, and, as a shared space with Biology, a laboratory/ classroom for the Environmental Science Program laboratories, ENVS 1130L. With the closure of the Natural Sciences Program in 2016, we moved the Environmental Science Labs to that space and gave up our half of the shared space with the Department of Biology. Ultimately, this made sense since both departments could fully utilize their respective lab spaces without having to put materials away for the half of the week the other department was using that space.

At the time of conception of the SMLC and up to its completion in late 2010, all of these classrooms/laboratories utilized space on the first floor of the E-W wing of Northrop Hall in rooms 114, 115 and 117. Part of the budget for the SMLC included backfill funds to renovate the vacated classroom space in Northrop Hall to create modern, functional teaching spaces, but a budget rescission in 2011 stalled this effort. Then Department Chair, Adrian Brearley was able to obtain UNM capital project funds to move this renovation forward. The Department revisited its original plan that only included rooms 114, 116 and 117 and proposed a revised plan in which room 114 would be renovated into graduate student office space, room 115 would be converted from the mineralogy teaching laboratory into a computer teaching laboratory and rooms 116 and 117 would be combined into a single large studio-type classroom for collaborative laboratory teaching for mineralogy, earth history and other laboratory classes, as required. An additional $250K in funds to complete the project was raised through a proposal from Chair Adrian Brearley to the President of the Frank and Marie Gorham Foundation, alumnus Tim Gorham, who generously donated $200K to the project. In addition, $50K from a variety of departmental resources was used. The classroom space was opened in 2014.

With these two new renovated and state of the art teaching facilities, the Department now has the following classroom/laboratory teaching spaces within Northrop Hall. Each of these rooms has been fitted with ceiling mounted digital video projectors. The new Natural History Science Center will also provide an additional classroom/laboratory space and graduate student offices. With the exception of Northrop Room 122 and the NHSC classroom, scheduling of classes in these facilities is controlled by the Department and are dedicated solely to instructional purposes within Earth and Planetary Sciences.

Room 105 – Teaching laboratory with a capacity of 24 was renovated in 2009 with funds from the Frank and Marie Gorham Foundation. This classroom was designed to be a flexible teaching space for teaching small lecture classes for EPS and ENVS majors, as well as laboratory classes for EPS 303L Igneous and Metamorphic Petrology and EPS Sedimentology and Stratigraphy.

Room 115 – Computer teaching laboratory with 24 PCs (updated in 2018) to run GIS software, Geophysics teaching software and statistics packages. This room features a teacher workstation and state of the art A/V system.

Room 116 – Studio-style collaborative teaching laboratory with a capacity of 56 students, seated around 8 round tables. Features teacher workstation and state of the art A/V system including a new laser projection system installed in 2018. This classroom is used for Mineralogy and Earth History.

Room 122 – Large 260 seat lecture theater used for large sections of introductory geology and environmental classes as well as our outside speaker series. Scheduling for this classroom is controlled by UNM central scheduling and is used widely for a variety of classes for other departments throughout the UNM campus. We installed two new laser projection systems using departmental funds in 2018 in an agreement with UNM IT who purchased a new workstation to run the A/V system. This arrangement meant that we could upgrade the A/V facility two years earlier than was planned for by central IT and benefits not only EPS, but all UNM users of this classroom theater.

Room 146 – Conference room/seminar classroom with capacity of ~20 used for small undergraduate/graduate classes as well as departmental faculty meetings.

Room 134 – Small seminar-style class room with seating capacity of ~ 12. Used extensively for small seminar classes, comprehensive exams, but in need of upgrades and renovation.

Room 340 – Lecture-style classroom with capacity of 40 students used for upper division undergraduate classes and graduate classes.

Science and Math Learning Center

The Science and Math Learning Center houses the GEOL 1110L Physical Geology Laboratory and the ENVS 1130L Blue Planet Laboratory. Each of these classrooms was designed and purpose built as a 1000-level teaching laboratory space for small laboratory sections and represent state-of-the-art facilities for instruction in these areas.

SMLC B64 – GEOL 1110L Physical Geology Laboratory is located in the basement of the SMLC building and is a fully equipped 1200 square feet teaching laboratory facility with work benches, specimen and map storage facilities and a capacity to teach laboratory classes of up to 26 students.

SMLC-B66 – ENVS 1110L Blue Planet Laboratory is also located in the basement of the SMLC building. This is a 1500 square feet multipurpose classroom/laboratory that was formerly used for the Natural Sciences Program and has since been repurposed for exclusive use for the Blue Planet Laboratory sections.

Natural History Science Center

This new facility includes a multidisciplinary classroom intended for specimen-based undergraduate and graduate courses. Suggested courses for this space include: EPS 411L Invertebrate Paleontology and ENVS 322L Life in the Earth system. Additional courses in the Biology, Anthropology, and Museum Studies programs, as well as the Honors College are expected to share this space.

EPS Research Laboratory Space (in Northrop Hall)

The Department houses a significant number of analytical laboratories that provide important instructional and research capabilities both for our own undergraduate and graduate students and for numerous students from other departments on the UNM campus. Many of these laboratories are run as multiuser facilities, in some cases acting as central core analytical facilities for the UNM, although they are not officially recognized as such. Nevertheless, they make a very significant contribution to the research infrastructure at UNM.

While some of these laboratories have recently been renovated and upgraded (many with laboratory funds), faculty and research staff continue to express concern about the adequacy of laboratory and research space to conduct high-level scientific research. A 2021 survey of faculty, research scientists, technicians and post-docs shows that the average rating for the adequacy of research space is 3.4 on a scale of 1-5, with 5 being excellent. Almost 80% of responses indicated issues with dust, followed by issues related to cooling, heating and ventilation. These laboratories host sensitive and expensive research instrumentation, that to replace would cost between $40,000 and $5M. Adequate and across the board renovations would not only provide the climate-controlled and dust-free space essential to continue our research mission in the department, it would also be conducive to an even higher level of research output and grant proposal success.

The sentiment of inadequate research space expressed by the faculty and research staff is also expressed by our graduate students who perform the bulk of the day-to-day research activities in these laboratories. The same survey indicates concerns about dust, heating, cooling and ventilation. In addition, many students cited insufficient space and issues with faucets and sinks. Of particular concern expressed by students are safety issues for the laboratories in the basement of Northrop Hall. There is inadequate lighting, inadequate security on doors, and a constant, terrible cockroach problem.

Radiogenic Isotope Laboratory

The Radiogenic Isotope Laboratory consists of sample preparation and clean lab spaces, elemental and isotopic analytical instrumentation and supporting infrastructure.
The main class 100 clean lab is supported by a 7,000 cfm multi-staged air-handler with pre-filters, charcoal and HEPA filters, with welded PVC ductwork. The main clean lab, about 1200 sqft, houses 1) wet chemistry work spaces for ion chromatography of a variety of samples, ranging from meteorites, terrestrial rocks and waters 2) a water purification area that supplies analytical-grade (18 Ω ohm) water at every sink in the lab continuously, 3) sample loading and weighing room with large-sample and ultrasensitive balances 4) an instrument den, currently housing our thermal ionization mass spectrometry and supporting instrumentation.

The thermal ionization mass spectrometer, a Micromass (VG) Sector 54, has seven standard Faraday cups and an ion-counting Daly multiplier for detection of small ion beams. In addition, it is equipped with a second-stage wide aperture retarding filter (WARP) for high abundance sensitivity isotopic analysis. Up to 20 samples can be analyzed manually or automatically in dynamic or static mode. The new mass spectrometer has extremely stable Faraday to Daly gain, better than 0.09% /1.5 hrs. The relative gain stability between the Faraday cups is extremely good, essentially a non-issue for static measurements lasting a few hours. The TIMS is now at the end of its duty cycle and thus we have move our Sr, Nd U-Pb and U-series analysis has now been ported to our multicollector ICP-MS. We are working on proposals to replace the instrument.

The second clean lab is our inductively coupled mass spectrometry facility. This facility is supplied with HEPA filtered air using a closet second-stage air-handler, using the building system as supply for makeup air. Aside from the ICP-MS units, the lab also has sample preparation rooms used for high temperature sample dissolution and handling of high concentration spikes. The ICP-MS mass spectrometers consist of a Thermo Neptune plus multi-collector ICP-MS (MC ICP-MS) and Thermo X-Series II quadrupole mass spectrometer (Q-ICPMS). The Neptune MC ICP-MS,has 9 Faraday cups, 5 channeltrons, and one secondary electron multiplier with a high abundance filter. The amplifiers consist of dynamically switchable boards, 5 have 1011Ω, 4 1012Ω and one 1010Ω resistors. The detection system has a large dynamic range, from single ion counting to 50x10-11A ion currents. The mass spectrometer is capable of operating in normal, medium and high resolution (13,000) modes. We are capable of measuring isotope ratios of non-gas elements across the periodic table, covering projects across a wide array of disciplines. We upgraded the Neptune to the Neptune-plus configuration using our in-house capabilities. The Q-ICPMS instrument has an electron multiplier that operates on analog and pulse counting modes, with a dynamic range >8 orders of magnitude, and very low backgrounds (<0.5 cps), allowing analysis of major elements and trace elements up to sub-ppt levels. A third-generation collision cell technology, eliminates matrix and argon-based spectral interferences. The instrument has high scanning range (>12,000 amu/sec) across the entire mass range. The sample preparation facilities including computer controlled micro-drill, large-sample carbonate saw. Within the clean labs, we have sample dissolution equipment at various temperatures. All the instruments are connected to a stable power system, consisting of high capacities UPS units, and an external backup generator. The Radiogenic Isotope Laboratory is directed by Professor Yemane Asmerom and assisted by Senior Research Scientist I Dr. Victor Polyak.

The Center for Stable Isotopes (CSI)

The stable isotope laboratory has undergone a significant expansion in facilities, users, projects and university wide collaborations since the last APR. Following the Department of Biology hire of Dr. Seth Newsome (who studies biological applications of stable isotopes), the EPS stable isotope lab facility was merged with Biology to create College of Arts and Sciences Category I Research Center with Dr. Zach Sharp as the director and Dr. Newsom as the associate director. This was the brainchild of then Associate Dean for Research, Kevin Malloy, Sharp and Newsome, who saw a chance to build a world class shared facility that would not require duplication of labs, mass spectrometers, and all the infrastructure associated with this facility. Initially, the CSI was established in several labs on the third floor of Northrop Hall. The facility quickly expanded in users from departments across campus (EPS, IOM, Biology, and Anthropology), and the Health Science Center. With many projects funded, CSI has become one of the highest visibility centers in the University. As the facility has grown since 2013, more instruments were added (with outside funding) making the space available in Northrop Hall too small. With the construction of the PAIS facility, most of the CSI infrastructure was moved to that new space in 2019/2020, but it still maintains space in Northrop Hall in Rooms 336 and 337 (2 mass spectrometers and 1 cavity ringdown laser spectroscopy unit). In 2019, UNM was selected to run the internationally recognized ISOCAMP in summer 2020, following the retirement of Dr. Thure Cerling at the University of Utah. ISOCAMP was cancelled last summer due to the COVID pandemic, but we hope to offer it this coming summer. https://isocamp.org/

As of 2020, the Center for Stable Isotopes (CSI) is a consortium of UNM faculty and staff dedicated to providing stable isotope capabilities to a broad range of both internal and external users. As noted above, the CSI is an outgrowth of the Stable Isotope Laboratory in the Department of Earth and Planetary Sciences under the direction of Professor Zachary Sharp. It now incorporates faculty, postdocs, graduate students and undergraduate students from 9 departments at UNM, and is now housed in the new Physics, Astronomy and Interdisciplinary Sciences (PAIS) Building, where it occupies 5 laboratory rooms and numerous offices for staff and students. The multi-million-dollar CSI hosts 9 mass spectrometers, 3 laser spectrometers and extensive peripheral equipment all centered on measuring the stable isotope compositions and ^{14}C of natural materials. CSI recently completed an agreement to move several mass spectrometers from a now closed facility at NM Tech, and these will go into the CSI space on the third floor of Northrop Hall. In addition, UNM–CSI has a radiocarbon (^{14}C) preparation laboratory under the direction of Dr. Keith Prufer (Anthropology). UNM–CSI is also equipped with a full glass blowing facility, a small mineral separation facility, including micro-saws, a magnetic separator, microscopes, dissecting equipment and heavy liquid-acid digestion facilities, five Sartorius microbalances, three convection drying ovens, a high-temperature muffle furnace, hot water bath, sonicator, freeze-drier, and a number of centrifuges for processing a variety of geological and biological samples.

Beyond UNM researchers, scientists from other New Mexico institutions and industry, and researchers from across the globe visit and collaborate with the CSI team. CSI generated over $5M in grants, averaging over $1M/year in new grants since 2016.

In the last year, CSI offered the following programs and activities

- CSI Pilot grants: Given to undergraduate/graduate students to conduct exploratory research. 24 grants awarded to date.
- CSI seminar: Weekly seminars given by faculty and students – averaging 20-30 attendees/week (now run remotely and includes researchers from around the world)
- Undergraduate employment: Support to help with routine analysis – 6 students employed
- Graduate Student assistantships: Two graduate assistantships/semester
- Courses: Stable Isotope Geochemistry (EPS 405/505); Elemental Ecology (Bio 402/502)
- Visiting classes: Both UNM and high school courses regularly tour CSI

Nanomaterials Characterization Facility

The Department of Earth and Planetary Sciences has operated and managed a X-ray diffraction laboratory since the 1950s and a Transmission Electron Microscope Laboratory since 1984 in laboratory spaces in Northrop Hall. In 2020, these two laboratories were integrated into the new Nanomaterials Characterization Facility that is housed in the new PAIS building. This facility is jointly operated by the Department of Earth and Planetary Sciences and the Center for Microengineered Materials (CMEM) in a collaborative venture to support and develop the nanocharacterization infrastructure at UNM. The current director of CMEM, Professor Fernando Garzon and past director, Distinguished Regents Professor Abhaya Datye, work closely with the NCF director, Distinguished Professor Adrian Brearley (who is also Associate Director of CMEM) to oversee and promote these facilities on campus. We are currently in the process of moving the instrumentation into custom designed, state-of-the-art laboratory space in the basement of the PAIS building that will integrate all our instrumentation into a single suite of analytical instrumentation, that also includes sample preparation, data analysis and research staff office space. These laboratories operate as multiuser facilities that are available to all campus users for research and are used by multiple departments and research centers on campus extending from the College of Arts of Sciences to the School of Engineering and the UNM Health Sciences Center. Our user base for these laboratories on an annual basis is ~140 users, dominated by graduate students (~70%), but also with an extensive user base of postdoctoral fellows, research faculty, and faculty as well as a significant number of undergraduate students. We also have a number of users from Sandia National Laboratories, Los Alamos National Laboratories, the Lovelace Respiratory Research Institute, and New Mexico Tech, as well as local high technology companies. The laboratories are also used extensively for educational purposes by several graduate classes and are also used by a number of undergraduates for their senior thesis research activities. The laboratory staff scientist salaries are supported mainly from the College of Arts of Sciences, with contributions from the Office of the Vice President for Research, contracts and grants, and user revenue. Each of the laboratories is operated as a service center and other operating costs for the instruments, such as service contracts and consumables, as well as some salary, are covered by UNM-approved user fee structures.

X-ray Powder Diffraction Laboratory

The XRD laboratory houses a Scintag PAD IV Powder XRD instrument which was purchased in 1984 and has been the workhouse instrument for our XRD laboratory since then. The instrument is controlled by Jade Power XRD software and has received various upgrades since then. In 2011, we were successful in obtaining an NSF MRI grant to upgrade our XRD facilities and in Spring 2012 installed a Rigaku SmartLab II powder XRD instrument as well as a Rigaku Rapid microX-ray diffractometer. These two instrument have added considerable new powerful XRD

capabilities to our facilities. The Rapid instrument in particular provides significant new research opportunities with the ability to obtain non-destructive power XRD patterns from very small samples and in situ from thin sections at a spatial resolution as high as about 30 microns, although 100 microns is generally more practical due to shorter pattern acquisition times. This laboratory is a multiuser facility directed by Distinguished Professor Adrian Brearley and managed by Senior Research Scientist Dr. Eric Peterson.

Transmission Electron Microscope Laboratory

The TEM laboratory has been located in the basement of Northrop Hall in the Electron Microbeam Analysis Facility, but moving forward will be located in the NCF in the PAIS building. We currently have three transmission electron microscopes. We were exceptionally fortunate in 2018 to be successful with a NSF MRI proposal for $2.5M ($1.75M NSF and $750K UNM costshare) to acquire an aberration-corrected scanning transmission electron microscope. After an exhaustive review of different instruments, we selected a JEOL JEM ARM200CF (NEOARM) instrument, which was ordered in February 2019 and delivered in February 2020. This instrument is a probe-corrected instrument with the ultrahigh resolution (UHR) pole piece, which will provide single atom imaging capabilities in STEM mode with a resolution of 71 pm. The instrument will be unique in the US in being the only NEOARM currently installed with the UHR pole piece. The NEOARM has a cold FEG emitter with an energy resolution of 0.31 eV. In TEM mode the point-to-point resolution is 0.19 nm. The NEOARM is calibrated in STEM aberration corrected mode to operate at 200 kV, 80 kV and 40 kV, providing exceptional versatility for imaging a wide range of different materials including beam sensitive organic materials including biological materials (soft materials). The instrument is equipped with a full range of detectors including secondary electron, backscattered electron, bright field STEM and high angle angular dark field STEM detectors. The instrument is also be equipped with two JEOL SDD 100 mm^2 EDS detectors for high-speed X-ray analysis and mapping down to the atomic scale. The EDS detectors will be controlled by JEOL EDS software, but we have also purchased the Oxford Instruments AZtec EDS software system with their complete suite of analytical packages for full spectral EDS mapping including real time X-ray imaging and full background corrected quantified EDS maps. The Oxford software system was recently approved by JEOL to control their EDS detectors and is an excellent addition to our EDS capabilities. The instrument also has tomographic imaging sample holders, which will enable tomographic imaging in STEM and EDS modes of thin samples and small particles enabling 3D reconstructions of complex fine-grained materials. We were also recently funded by the NASA Planetary Major Equipment and Facilities program (PMEF) to acquire a GATAN Continuum electron energy loss spectrometer/image filtering system, for the NEOARM which will add a significant additional array of capabilities to the instrument, including single atom chemical analysis and high spatial resolution oxidation state measurements. This EELS system will be installed on the instrument in early fall 2021.

In 2000, we installed a JEOL 2010F FASTEM TEM/STEM instrument that was purchased with funds from NSF and the University of New Mexico. This instrument has a number of analytical capabilities including energy filtered TEM imaging (EFTEM), electron energy loss spectroscopy (EELS), X-ray microanalysis and X-ray mapping at the subnanometer level, and bright and dark field STEM imaging, as well as traditional TEM techniques such as electron diffraction and high-resolution imaging. The JEOL 2010F has a 0.19 point to point resolution in TEM mode and

a guaranteed spot size of 0.16 nm in STEM mode, although it has been demonstrated to reach a spot size of 0.14 nm on our instrument. The instrument has a high angle annular dark field detector (HAADF) for atomic resolution Z-contrast imaging in the STEM mode. This instrument is equipped with a GATAN GIF 2000 image filtering (GIF) system for energy-filtered TEM (EFTEM) and electron energy loss spectroscopy (EELS), an Oxford ultrathin window EDS detector connected an Oxford AzTEC EDS system with X-Max 80 80mm^2 SDD detector. Our current plan is to phase this instrument out over the coming year as the NEOARM becomes fully operational.

We also have a JEOL 2010 200kV high resolution transmission electron microscope capable of a 0.19 nm point to point resolution. A GATAN Orius camera is fitted to the instrument allowing acquisition and processing of digital images using GATAN Microscopy Suite. This instrument is equipped with an Oxford Analytical ISIS EDS analytical system which uses an ultrathin window EDS detector capable of detecting all elements down to boron. This instrument is becoming increasingly challenging to maintain due to its age, so we recently acquired a newer JEOL 2010 (2006) from Sandia National Laboratory, which we will be moving to the new PAIS laboratory in Spring 2021. This instrument is an excellent workhorse and training instrument which complements the very advanced capabilities of the JEOL NEOARM.

The laboratory is also equipped with a full range of sample preparation equipment including GATAN PIPS ion beam milling instrument, ultramicrotome (RMC Ventana), and carbon coaters. Upgrades to the facility, including a new ion milling instrument ($57K) and upgrades to the digital camera capabilities ($85K) on the JEOL 2010F, have been supported by the NASA PME program. This laboratory is a multiuser facility directed by Distinguished Professor Adrian Brearley and managed by a Senior Research Scientist (position currently open) assisted by a Research Scientist (position currently open).

Focused Ion Beam/Field Emission Gun Scanning Electron Microscope (FIB/FEG SEM) Laboratory.

This laboratory located houses an FEI Quanta 3D FEG Dualbeam focused ion beam/field emission gun scanning electron microscope (FIB/FEGSEM) which was installed in the Electron Microbeam Analysis Facility in the basement of Northrop Hall in late Fall 2008. The instrument is a high resolution FEGSEM that is also capable of a wide range of nanomachining and nanofabrication applications using the ion beam column and is used extensively for the preparation of site-specific TEM samples. The instrument is equipped with full in situ sample lift out capabilities for removing TEM foils from samples using an Omniprobe AutoProbe 200.2 micromanipulator. In addition, the instrument also is equipped with an EDAX Genesis EDS system with an Apollo 40 SSD detector for X-ray microanalysis and a EDAX/TSL EBSD system for electron crystallography. The Quanta FEG 3D is also an environmental SEM and can be used to study uncoated samples under controlled vacuum conditions. The laboratory is a multiuser facility directed by Professor Adrian Brearley and managed by a Senior Research Scientist assisted by a Research Scientist. Both research scientist positions are currently open.

Ion Microprobe Facility

The ion microprobe facility at UNM houses a Cameca IMS 4f secondary ion mass spectrometer (SIMS) that will be used for trace element and some isotopic analyses. The instrument is

equipped with both oxygen and cesium primary ion beam sources and is capable of analyses with a spatial resolution of <30 μm. The instrument was originally housed at Sandia National Laboratory but was donated and moved to UNM in 2001. Varies software and hardware improvements have been made to the instrument over the past several years and it remains an important instrument that is directed Research Professor Dr. Chip Shearer (Institute of Meteoritics, UNM).

Volcanic and Hydrothermal Gas Analyses Laboratory UNM (aka UNM Volatiles Lab). The laboratory includes a high vacuum system for sample preparation and introduction into the analytical system. The gas compositional analyses are performed by a combination of Gas Chromatography (with highly sensitive discharge ionization detector) and Pfeiffer Quadrupole Mass Spectrometer. The wet chemical facilities include titration devices that are used to analyze the caustic solutions of gas samples. All gas sampling field equipment and flasks are available for immediate sample collection from springs, fumaroles, soils at any temperature (ambient to 1,100 °C). Noble gas abundances are analyzed with the Quadrupole MS following gettering on the vacuum line. The QMS is also used for $^{40}Ar/^{36}Ar$ analyses and recently achieved precision of ± 0.5 %. There are two charcoal traps that can be cooled to LN2 temperature to absorb heavy noble gases.

Three PP Systems CO_2 accumulation chambers are available for soil CO_2 flux measurements (EGM-4/5). These instruments were modified to allow the collection of gas samples from the chamber into evacuated glass vials. The vials can then be analyzed for stable isotopes and gas chemistry. A benchtop Delta Ray Infrared Spectroscopy carbon isotope analyzer allows for rapid analyses of C isotopes in CO_2 as well as CO_2 contents. The instrument is housed in the volatiles lab. This instrument was used on site during an expedition to the Aleutians and to Erebus Volcano. Most recently, former Ph.D. student Kristen Rahilly used this instrument for dozens of C-isotope analyses from Yellowstone and Valles Caldera as well as hydrothermal systems in Utah. The samples that can be analyzed for CO_2 are gas samples ranging in CO_2 content from 200 ppm to 100%. A field portable USB UV SO_2 spectrometer (miniDOAS) that has been used extensively to determine SO_2 concentrations of volcanic plumes at volcanoes world-wide.

Recently, the volatiles lab has built multiGAS instruments for continuous measurements of volcanic gases. One is currently operating in the Jemez Mountains with satellite data transmission. A Y6 drone is available for volcanic plume sampling and sensing. The volatiles laboratory is directed by Professor Tobias Fischer.

Analytical Chemistry Laboratory
The Analytical Chemistry Laboratory is located in the second floor, room 213 of Northrop Hall Building #24 at the Earth and Planetary Sciences Department. The laboratory is under the direction of Senior Research Scientist II, Mehdi Ali, PhD. The laboratory is staffed with highly experienced personnel and state of art computer controlled instruments.
The primary mission of the laboratory is to support the Department's (Earth and Planetary Sciences) teaching and research programs for geo-chemical analytical needs. Secondary mission is to support various chemical (organics and inorganics) and biomedical analytical services and needs for other UNM departments and institutes, other universities and educational institutes, federal, state, city, and public agencies and industries. Also provide training and teaching for

students and laboratory users for the proper analytical techniques. Providing aid to students, staff, and faculty to support their research programs related to chemistry, geochemistry, and biomedical studies. The laboratory is classified as service center facility that can provides support and services for many other groups including other UNM Departments, government agencies, and private sectors on a structured fee bases as approved by UNM general accounting office.

The Laboratory is equipped with various types of instruments and samples preparation and processing apparatus. These instruments include:

1. Three PerkinElmer Inductively Coupled Plasma – Optical Emission Spectroscopy (ICP-OES) systems "Optima 5300DV, Optima 4300DV, and Avio 500" for majors and minor elements analysis.
2. PerkinElmer NexION 300D Inductively Coupled Plasma – Mass Spectrometer (ICP-MS) for trace elements analysis.
3. Flexar PerkinElmer High Performance Liquid Chromatography (HPLC) for trace elements speciation. This system can be coupled and interfaced with the NexION ICP/MS for speciation type of analysis.
4. Flexar PerkinElmer High Performance Liquid Chromatography (HPLC) for organics compounds and inorganic elements analysis. The system is equipped with UV-VIS and ECOM electrochemical detectors.
5. Flow injection Mercury System (FIMS) analyzer for trace level Hg analysis.
6. Rigaku Primus IV ZSX X-Ray Fluorescence System (XRF) for majors and minor solid samples elemental analysis. Also this system is capable of analyzing various types of aqueous samples for both major and minor elements.
7. New Wave Laser Ablation Elemental analysis of solid samples. This system is also equipped with CryoCell for biota and biomedical samples analysis. The system can be coupled and interfaced with the NexION ICP/MS for these type of analysis.
8. Dionex ICS-1100 Ion Chromatography system that can be used for various types of aqueous samples analysis such as anions, amino acids, proteins, perchlorates, …etc.
9. Waters UPC^2 Supper Critical Fluid – Ultra High Pressure Liquid Chromatography / Mass Spectroscopy System. This system is equipped with three detectors Photo Diode Array (PDA), Electro Light Scattering (ELS), and Mass Spectrometer. The system can be used for both organic compounds and inorganic elemental analysis at trace levels.
10. Various types of samples preparation and processing apparatus for different sample analysis techniques.

All these instruments were purchased through NSF funding and donations from the Department of Energy (DOE). The laboratory supports various research and teaching programs for different UNM departments such as college of Engineering, Water resources program, college of Arts and Sciences including north campus (College of Pharmacy and Medicine and the School of Biomedicine). The laboratory also supports the Sandia and Los Alamos national labs and the USGS for their analytical needs and services. Several privet and public companies and mining utilize the laboratory for their analytical needs. The laboratory implements stringent Quality Assurance and Quality Control (QA/QC) comparable to US EPA protocols as part of samples analysis and testing.

The laboratory is a service center facility that provides services to various city, state, federal, and public agencies, institutes, and companies. The laboratory is managed by a laboratory director (Mehdi Ali, Ph.D.) and assisted by student workers and volunteers.

1-Atm Furnace Experimental Petrology Laboratory
The high temperature experimental petrology laboratory at UNM has two Deltech furnaces, both with gas-mixing capabilities and programmable temperature control. One uses a gas mix of H_2-CO_2, and the other CO-CO_2. Both furnaces are operational up to ~1600°C under a wide range of oxygen fugacities.

High Pressure Experimental Laboratory
The experimental petrology lab houses three solid-media experimental devices: two Walker-style multi-anvil presses (2000 ton and 600 ton) and a Depths of the Earth piston-cylinder (with 13mm and 9mm pressure vessel bore holes). The multi-anvil press is capable of achieving pressures from ~3 GPa to nearly 24 GPa, and the Depth of the Earth piston-cylinder spans a pressure range of ~0.3 to ~1.5 GPa. The 2000-ton press has been recently upgraded with a new syringe pump and pressure/temperature controller, which not only increases the success rate of the experiments due to the small pressure increments powered by the syringe pump, but also allows phase equilibrium or sample synthesis experiments with long-term pressure/temperature stability up to several days. These presses can achieve conditions relevant to regimes ranging from the mid-crust to the mantle transition zone on Earth; from deeper crust to nearly the core-mantle boundary on Mars; and from deepest crust to beyond the center of the core on the Moon and asteroid parent bodies. Sample preparation stations are available for the multi-anvil press sample assemblies as well as microprobe/SEM sample preparation. The High Pressure Experimental Petrology Laboratory is directed by Professor Carl Agee and Assistant Professor Jin Zhang.

Micro-FTIR Laboratory
The chemical spectroscopy laboratory in the Institute of Meteoritics at the University of New Mexico currently houses a Nicolet Nexus 650 Fourier Transform infrared spectrometer and a Nicolet Continuum Infrared Microscope with Infinity-corrected optics, combining the high-performance mid- to near-infrared sampling and excellent visible-light microscopy in one desktop unit. The spectrometer is continuously purged with dried, CO_2-free air. The instrument is equipped with a Globar source, CaF_2beam splitters, the liquid nitrogen cooled MCT-A detector and deuterated triglycine sulfate (DTGS) detector. The FTIR spectra can be collected under either reflection or transmission mode on samples as small as 100 μm in size. The laboratory is managed by Assistant Professor Dr. Jin Zhang.

Diamond Anvil Cell (DAC) Sample Preparation laboratory The laboratory is equipped with several stereo and polarized microscopes, EDM machine for drilling gaskets, diamond alignment jigs, oven, digital balance, vacuum chamber, cutting and polishing machines. Lab users will be able to polish, prepare and load samples in DAC and get ready for the high pressure-temperature experiments. The laboratory is managed by Assistant Professor Dr. Jin Zhang.

High pressure-temperature Brillouin and Raman spectroscopy laboratory The Brillouin spectroscopy system is capable of measuring the single-crystal or poly-crystal elastic properties

of Earth and planetary materials up to Mbar pressure and several thousand degrees through CO_2 laser heating and resistive heating method combined with DAC. The pressure-temperature range covers the conditions that are expected through the Earth's interior from mantle to the core. The Raman spectroscopy system probes the vibrational spectroscopic characters of materials and can be used for studying their structural properties. Both laser systems use a 532 nm single-mode diode-pumped solid-state laser as the light source. The laser systems are enclosed in a polycarbonate plastic enclosure for safety protection. The laboratory is managed by Assistant Professor Dr. Jin Zhang.

Sedimentology Laboratory
The sedimentology lab has wet lab facilities for standard sample processing workflows. The lab contains a fume hood with plumbed compressed air, chemical-resistant work surfaces, and standard sample processing equipment including a laboratory scale, oven, sonicator, hot plate, and centrifuge. Three work stations in the sedimentology lab are configured for microscopy work, with petrographic (Leica DM EP) and stereo (Nikon SMZ-645) microscopes. The lab's Nikon SMZ-25 stereo microscope, and Olympus and Nikon Optiphot Pol petrographic have been relocated to office space ahead of planned lab renovations. The sedimentology lab contains a walk-in climate controlled cooler room for storage of sediment cores and water samples. Frozen samples are stored in a separate chest freezer. Dr. Tyler Mackey oversees the Sedimentology Lab.

Diagenesis Laboratory
The Diagenesis Laboratory (low temperature geochemistry/aqueous geochemistry) is equipped with field instrumentation for installing shallow monitoring wells, and an extensive array of continuous sensors for the measurement of water level, temperature, conductivity, pH, dissolved oxygen, turbidity, nitrate, iron and sulfide in surface waters (streams, springs and lakes) as well as subsurface (wells). Leveloggers, barologgers, YSI sondes, and YSI multparameter probes in addition to standard Oakton multimeters and an automatic titration system are available for determination of basic water quality parameters and environmental monitoring. The laboratory has autotitrators for rapid and accurate determination of alkalinity, and preparatory facilities (including an IEC high-speed centrifuge and ultrasonic dismembrator) for clay mineral separation. A computer workstation includes an array of geochemical software including Aquarius hydrometric workstations and a server for continuous data sensor data management and Geochemist's Workbench for geochemical modeling. The Diagenesis Laboratory is directed by Professor Laura Crossey.

Collections Facilities
The Department maintains large collections of mineral, fossil and rock specimens, housed in the basement of Northrop Hall. Part of these collections are used in teaching, but the bulk of the specimens are accessioned into reference or research collections. The accessioned collections include over 25,000 minerals and ~ 25,000 fossils. A small percentage of which are cataloged in a computer or online database. The UNM mineralogy collection is one of the larger such collections curated at a North American university. The UNM paleontology collections include unique regional specimens of flora and fauna, as well as several fossil type specimens. A small portion of the specimens are on display in our departmental Geology Museum. Unfortunately, due to dwindling departmental resources and the retirement of Professor Barry Kues who was the primary faculty member with curatorial responsibility for the collections and museum, our ability

to maintain, digitize, update, and make these valuable collections visible has been severely reduced. This limits the utility of these collections for both in-house UNM research and contribution to broader researchers via specimen loans. In addition, the Institute of Meteoritics maintains one of the world's most extensive collections of meteorites, and some of these are on display in the Meteorite Museum. Professor Carl Agee, Director of the Institute of Meteoritics has primary curatorial responsibilities for this Museum. Both museums, which are maintained by the Department and Institute without direct support from the University, are open without charge to the public, and are visited by 5,000 people (many of them classes of school children) each year. Accordingly, both Museums represent a major education of resource for the University and New Mexico in general.

Natural History Science Center

The Natural History Science Center at the University of New Mexico, formally known as the Biology Annex Building, is an historic building that was designed and built in 1948 by renowned southwestern architect John Gaw Meem. The vision for this new space, to open in summer 2021, is to provide a centralized teaching and research space that supports the integration of biodiversity collections and researchers on campus. This includes faculty, graduate, and undergraduate students in programs spanning two colleges (Arts and Sciences, Honors) and four UNM-Main Campus departments (Earth and Planetary Sciences, Biology/Museum of Southwestern Biology, Anthropology, Museum Studies). The Natural History Science Center will enhance effective educational opportunities for our graduate students (for example through interdisciplinary engagement and research) and undergraduates (for example through specimen-based lab and museum science courses and research opportunities); the space also provides a new and centralized location for public engagement and outreach in specimen-based sciences; indeed part of the design includes features to enhance interactions with local/regional school groups and community open houses/lecture series. The building will also provide a state-of-the-art fossil preparation space and collections space to house the 25,000+ research grade fossil specimens currently in the UNM Paleontology collection. This collection primarily includes marine invertebrate and terrestrial plant fossils and spans the entire Phanerozoic Eon. Whereas the geographic scope of specimens is global, the collection is especially strong from New Mexico and the surrounding region. Many of these regional specimens are not well represented in other academic or national museum collections. Flora and fauna from the Carboniferous, Permian, and Cretaceous Periods are particularly well represented. The collection also includes more than 50 type specimens of Pennsylvanian and Early Cretaceous mollusks, and Pennsylvanian insects. Notably, federal collections guidelines dictate that repositories of vertebrate fossil remains provide environmental controls (e.g., temperature and humidity) to ensure collections do not degrade over time. UNM has historically not had this type of facility, and thus prior vertebrate fossil collections (e.g., current faculty work in fossil mammals and dinosaurs) have had to be reposited in other museums. Thus, another exciting aspect of the new NHSC collections space will be the ability to retain permanent research collections of vertebrate fossils collected by UNM faculty and student researchers.

Harding Pegmatite Mine.

The Department also manages the Harding Pegmatite Mine in Taos County, northern New Mexico. This inactive mine, a classic zoned pegmatite with an unusual array of rare-earth and other minerals, was donated to the University by Dr. Arthur Montgomery about 15 years ago.

The Department maintains an extensive research collection of Harding materials (including extensive diamond drill core) and an archive of documents, maps and photographs related to the mine. It is utilized by the Department as an outdoor laboratory, and is also open to the public for visiting and limited mineral collecting, with prior permission from the Department. A half-time Department staff member, Mr. David Griego, serves as caretaker for the property, which is visited by about 2000 people per year. Much more additional information about this resource can be found on the Department's website.

Departmental Field Vehicles
In addition to laboratory facilities that serve the instructional and research needs of faculty and graduate students, the Department also maintains a fleet of 5 field vehicles, all of them 4-wheel drive, and ranging in size from 8 to 9 passenger. These vehicles are used for most course-related field trips and are available for faculty and graduate student field research, and travel to professional meetings. A large inventory of field equipment is also maintained to support our summer field classes.

Mineral separation/rock crushing/rock cutting facility
Rock crushing facilities include a shatter box, jaw crushers, a sandblasting unit, large slab saws, trim saws and thin section grinders. There are diamond and alumina lap wheels available for preparation of most geological materials.

9B: Future Space Needs *Discuss any future space management planning efforts related to the teaching, scholarly, and research activities of the unit. Include an explanation of any proposals that will require new or renovated facilities and how they align with UNM's strategic planning initiatives.*

- *Explain the potential funding strategies and timelines for these facility goals.*

The Department has expanded its teaching and research space over the last decade, as described above. Our teaching facilities have expanded into the SMLC building and the completion of the PAIS building in 2020 has allowed several of our research facilities to expand into that space. Both teaching and research in Paleobiology will be greatly enhanced once the renovation of the Natural History Science Center is completed (anticipated completion in summer 2021). However, as noted in the facilities description, there are many aspects of labs in Northrop Hall that need significant renovation and upgrades.

To that end, the Department has been very active in seeking State Capital Improvement funds to upgrade our facilities. We were fortunate to obtain $150,000 from the State of New Mexico with the help of State Senator Bill Payne, for a complete renovation of the Silver Family Geology Museum. That project is currently in Phase II with an architect hired and renovation to begin in spring 2021. We were also fortunate to obtain Capital Outlay Funds for research laboratory improvements in Northrop Hall (with the strong support of Dean Mark Peceny and Associate Dean for Research Tom Turner). These State Capital Outlay funds were augmented with additional funds from the Provost's Office. This project will include a newly renovated and expanded Sedimentology lab for Dr. Tyler Mackey, and newly renovated and expanded Optical Table lab for Dr. Jin Zhang and a renovation of the existing XRD lab once that facility moves to PAIS. The tentative plan for that lab space is a planned hire in the area of Surface Processes.

This project has just been assigned a new project manager, and is beginning Phase II with and architect hired who is beginning to draft renovation plans.

A plan to convert the old Biology Annex Building into a new Natural History Science Center was implemented by then Acting Associate Dean for Research, Laura Crossey, and Assistant Professors Cori Myers and Jason Moore (Honors College) in 2017. The UNM Regents approved a substantial project, including some $3.9 million in construction costs, to renovate the building into a modern fossil research and collections facility. This includes a complete gutting of the building, installation of a new roof, and installation of a new HVAC system, insulation etc. However, these funds did not include purchasing specimen cabinets, teaching tools and furniture. We were fortunate to have obtained two separate Capital Outlay grants from the State of New Mexico, the first for $103,000 (in 2019) and the second for $195,000 (in 2020) which was the UNM Graduate Student Association primary request to the State Legislature. However, cost overruns in the construction have required the project manager to sequester those additional Capital Outlay funds as a contingency against past and future cost overruns. The first grant was entirely used for construction cost overruns, and the second (2020) grant has been held in a contingency fund in case "hidden conditions" come up. If this grant is used in the base construction, there will be no funds for classroom setup or outreach spaces including acoustic baffling, specimen cabinets and projectors. While the original legislative language apparently allows this grant to be used for the basic facility costs, this sequestration runs counter to the original purpose of the legislative request – namely to establish the teaching and research facility within the building. However, even with this funded allocated to its intended purpose, the Natural History Science Center still requires substantial additional investment ($750-$1000K) to enable the space to operate as the world-class paleontological collections and research facility that it was designed to be. Finally, funds have not been identified to hire a Collections Manager to aid in the curation and maintenance of teaching and research collections/equipment in this new building. Without the aid of this research staff position, even moving teaching and research collections into this space will be substantially delayed.

Conclusion. Strategic Planning

Discuss the unit's strategic planning efforts going forward to improve, strengthen, and/or sustain the quality of its degree programs (if applicable, differentiate between undergraduate and graduate). Address all criterion, including but not limited to: student learning outcomes, curriculum, assessment practices, recruitment, retention, graduation, success of students/faculty, research/scholarly activities, resource allocation, and facility improvement.

The Department of Earth and Planetary Sciences has numerous strengths that have allowed us to achieve a nationally and internationally recognized level of excellence. This has been achieved despite limited and, at present, diminishing institutional resources. Currently, we are the highest nationally ranked STEM department at UNM. We are also among the top ranked departments at UNM in terms of F&A per faculty and in the top three in the College in total F&A generated (FY 2020). This is clearly a result of our long-term investment in instrumentation and associated technical support, our strength in field-based research, and the creativity and hard work of our faculty, research professors, and students. We now have a very strong geophysics group (3 faculty, several post-docs and many graduate students) that was just beginning to develop in

2013, and we have reinvigorated our strength in Paleobiology and in Petrology with dynamic new hires (many new graduate students and post-docs in those areas as well).

However, we have lost both our Surface Processes / Geomorphology faculty (Grant Meyer, Les McFadden) to retirements, and most recently our Climatologist, Dave Gutzler, retired as of December 31, 2020. Since 2013, we are down a net number of 3 faculty members despite several new hires due to accelerating rates of retirement and separations at the senior faculty level. The demographics of our senior faculty and research scientists suggest that we will continue to see additional retirements over the next few years. The department faculty has collectively developed a long-term plan for future hires and directions at the request of the Dean. Surface Processes and Climatology or Hydroclimatology are identified as our highest priorities for new hires. In fact, the College of Arts and Sciences had approved a Surface Processes hire two years ago at the same time the Geodesy position was approved; however, only one of those hires was approved at the Provost Level due to concern about funding and enrollments. We are also mindful of the tremendous investment made in our research laboratories and have in our strategic hiring plan a position in Stable Isotope Geochemistry, a position in Earth and Planetary Materials (that could be another joint hire with the IOM) that would take advantage of our Nanomaterials Characterization Facility (TEM, XRD) as well as positions in Planetary Geology (also a possible joint hire with IOM), Structure / Tectonics, Biogeochemistry and Ocean Sciences. Clearly, faculty hires will be limited over the next 2-3 years as UNM adjusts to the pandemic-related enrollment declines and the State budget; however, our top hiring priorities in Surface Processes and Hydroclimatology are essential to the continued research and teaching strength of the department, will have broad interdisciplinary impacts (e.g., Water Resources Grand Challenge, Climate Change) and address critical societal needs for the state and the country.

The Department has an excellent faculty who are very research active and highly committed to teaching at all levels of the curriculum including at the 1000-level. All our faculty currently hold active research grants that collectively support the majority of the students in our graduate program as well as providing support and research opportunities for undergraduate students. We are also very fortunate to have outstanding analytical facilities that have been established and maintained by the hard work and commitment of faculty and research staff. In this regard, the support of the College of Arts and Sciences in providing salary lines for some key research staff to manage these laboratories is a major strength of the Department. This analytical strength of the Department cannot be understated: it allows national and international competitiveness for funding, and it allows members of the Department to do cutting-edge research that raises our national and international visibility. We strive to make our lab facilities openly available to all interested users on the UNM campus and with external collaborators. The high level of research grant success among the EPS faculty has played an essential role in supporting our analytical facilities.

A major challenge the department faces is the enrollment decline in our 1000-level classes due to changes in the State and the University core curriculum, on top of general declines in enrollments at UNM for the last few years. We gain most of our majors by attracting them into the discipline with these introductory classes, as geoscience is typically not taught at the high-school level and students are not as familiar with it. This is an issue that faces many Geoscience departments across the country. We are also facing an immediate decline in our EPS majors that

will require attention and thought over the next year. We faced a similar decline in our revised ENVS major two years ago, and following a survey of our students and help from our College Advisor, Maggie Summruld, worked to streamline the core class sequence and decided to offer the gateway course (ENVS 320L; Environmental Systems) twice a year rather than just in the fall. As a result, the numbers of ENVS majors has rebounded significantly in the last year. We have begun discussion on how to streamline our course offerings between the two degrees in response to our decreasing faculty numbers, and need to extend this discussion as we consider modernizing our EPS degree programs. We feel that our new ENVS degree is stable and growing in interest and enrollments, but our EPS degree has not seen significant revision in decades. Given our recent emphasis on geophysics, paleobiology, and an earth systems approach in our ENVS degree, there are several directions that the department could go in updating our EPS degree. However, we do not have a consensus as to how best to approach that, and the pandemic has limited our ability to move forward with revisions. We anticipate that once we return to a new "normal", those discussions can begin again – hopefully as soon as fall 2021. The analysis of student data in this report also show areas where we should consider changes to benefit our students. For example, there is a marked disparity in time-to-degree between men and women in our EPS degree (Table 10), that may reflect difficulties with required supporting math and science classes. It may be something else – we need to find that out.

Our long-term vision involves having the Department of Earth and Planetary Sciences at the center of one of the strongest interdisciplinary programs at UNM and indeed in the country. We are working with other departments, the College, and other Colleges to develop one of the highest ranked Earth, Planetary, and Environmental programs in the U.S. that builds on existing UNM strengths. In addition, our Department has diversity goals and demographics that, like UNM in general, make us "the future face of the geosciences" in the U.S. Both our EPS and ENVS degrees attract a large number of Hispanic and Native American students, and our departmental support and pyramid mentoring style promotes their success and placement into the workforce or graduate school. Our graduate programs already successfully mentor many women and underrepresented minorities in STEM, and we plan to substantially increase our impact in training of a diverse scientifically trained workforce.

In summary, our national ranking is remarkably high despite our declining numbers of faculty and the decline in other university resources over the last decade. We have leveraged our grant and contract success and success with alumni donations to counteract some of these trends, but not all. We have been fortunate to have been able to hire excellent young faculty with the strong support from the Dean, but we recognize that each new hire comes with significant start-up costs and space needs. We have used unrestricted alumni donations to help with this, but are finding that our retirements are outpacing our new hires (as predicted at the time of the last APR). Since the last APR, we have increased our grant and contract productivity, continued (if not increased) our publication rate, have built new world class research labs and facilities, and our faculty are deeply involved in high-profile research initiatives across the board. We have begun the process of updating our degree programs but still have work to do. Similarly, we have begun to more directly address issues of diversity and equity, but again, we have more work to do. This is an exciting time to be in a geoscience department. There are many challenges and opportunities and a healthy, robust Department of Earth and Planetary Sciences will be a credit to the University of New Mexico and to the State of New Mexico.

Appendices

Appendix 1: [EPS Curriculum Matrix: Programmatic and Learning Outcomes]

Learning Outcome/objective	The Blue Planet (ENVS 1130)	The Blue Planet Lab (ENVS 1130L)	F/Sp ENVS 320L (4): Environmental Systems (*formerly ENVS 330)	Sp ENVS 321L (4): Earth Materials / Critical Zone	F ENVS 322L (4): Life and the Earth Systems	F ENVS 315 Statistics in Earth Sciences	F ENVS 323L (4): Water in the Earth System	Sp ENVS 324 (3): Earth's Climatic Environment	Sp ENVS 430L: Advanced Environmental Systems / Environmental Field Methods (Capstone)	F/Sp EPS 401: Colloquium	F/Sp EPS 490: Geologic Presentations
	ENVS CORE CLASSES										
	3	1	4	4	4	3	4	3	4	1	1
Pre-Requisites	None		ENVS 1130/1130L OR GEOL 1110/1110L; MATH 121	ENVS 1130/1130L OR GEOL 1110/1110L; MATH 1240 or MATH 1250; CHEM 1215/1215L	ENVS 1130/1130L OR GEOL 1110/1110L; MATH 1240 or MATH 1250; BIOL 1140/1140L		ENVS 320L; MATH 1512; PHYS 1310; CHEM 1225/1225L; CS 151L	ENVS323L; MATH 1522; PHYS 1320	ENVS 323L		
Co-Requisites	None				ENVS 320L	MATH 1522	MATH 1522; ENVS 315		ENVS 324		
CLASSES YOU SHOULD BE TAKING	Math 121 or Math 150 or Math 153; CHEM 121/123L	MATH 121 OR MATH 150 OR MATH 153; CHEM 121/123L	CHEM 122/124L; MATH 150 OR MATH 153	MATH 162	PHYS 160		ENVS 315; MATH 1522				
Faculty:	Staff	Pun	Weissmann Scuderi	Worthington Meyer Fischer	Myers	Gutzler Galewsky Schmandt	Weissmann Galewsky	Gutzler Fawcett	Galewsky Crossey	Staff	Staff
Computer Methods			Computer Methods		Computer Methods	Computer Methods	Computer Methods		Computer Methods		
Computational Methods			Computational Methods		Computational Methods	Computational Methods	Computational Methods	Computational Methods	Computational Methods		
Term Paper			Term Paper						Term Paper		
Poster Presentation			Poster Presentation						Poster Presentation		
Oral Presentation					Oral Presentation				Oral Presentation		Oral Presentation
Group Projects					Group Projects		Group Projects		Group Projects		
Field Work			Field Work	Field Work	Field Work		Field Work		Field Work		
Programmatic SLOs:											
A. Content Mastery Goals: Students will evaluate Earth processes that occur within and between different spheres in the Earth system (atmosphere, hydrosphere, biosphere, and geosphere)											
P1. Students will employ critical thinking skills to solve problems related to the interplay of physical, chemical, geological, atmospheric, and biological processes across the spectrum of spatial and temporal scales relevant to Earth's systems.	Introduced	Introduced	Practiced	Practiced	Practiced		Practiced	Assessed	Assessed		
P2. Students will apply environmental systems knowledge to solve societally relevant problems (e.g., site environmental characterization, climate change, water supply).	Introduced	Introduced	Practiced	Practiced	Practiced		Practiced	Assessed	Assessed		
B. Skill Mastery Goals: Students will construct and test hypotheses using modern scientific equipment and/or appropriate quantitative methods.											
P3. Students will design/test and/or evaluate scientific hypotheses.	Introduced	Introduced	Practiced	Practiced	Practiced		Practiced	Practiced	Assessed		
P4. Students will apply quantitative skills to interpret environmental data (e.g., statistically analyzing and interpreting environmental science data) and/or use multiple types of data at different spatial and temporal scales (e.g., conducting and integrating field, laboratory, remote sensing and computational analysis to generate and interpret new data), evaluating the quality of the data sets they use.			Introduced and Practiced		Practiced	Practiced	Practiced	Assessed	Assessed		
C. Communication Skill Goal: Students will effectively present scientific data and arguments in oral and written formats.											
P5. Students will present written and/or oral communication for research or education or public audiences and appropriately cite primary literature.			Introduced and Practiced				Practiced		Assessed		
D. Scientific Integrity Goal: Students will conduct scientific work according to ethical and professional standards.											
P6. Students will apply scientific integrity and ethics as reflected in evidence based analysis and respectful interactions with colleagues at all education and career levels (e.g., written and verbal communication with colleagues and lawmakers; submitted journal articles, abstracts and class papers; and oral presentations).			Introduced	Practiced	Practiced	Practiced	Practiced	Practiced	Assessed		
E. Career Preparation Goal:											
P7. A majority of the Environmental Sciences students (75%) will participate in career preparation activities.											Assessed
Skills:											
Computational Skills:											
S1. Students will be able to apply algerbraic equations to solve Environmental Science problems.			Practiced		Practiced	Practiced	Practiced	Practiced	Practiced		
S2. Students will be able to apply basic statistics to analyze a data set.			Practiced		Practiced	Practiced	Practiced	Practiced	Practiced		
S3. Students will be able to evaluate and generate data for use in time series and geospatial analysis.			Practiced		Practiced	Practiced	Practiced	Practiced			
S4. Students will be able to solve derivatives and integrals as related to Environmental Sciences, and evaluate differential equations analytically or numerically.			Practiced			Practiced	Practiced	Practiced			
S5. Students will be able to write equations and evaluate fluxes in an Earth system using finite difference solutions.			Practiced		Practiced	Practiced	Practiced	Practiced			
S6. Students will be able to apply and evaluate geochemical reactions in a natural system using geochemical modeling software.			Practiced								
S7. Students will be able to demonstrate proficiency in using 3D analysis and visualization software.			Practiced				Practiced	Practiced			
GIS skills:											
S8. Students will be able to download data from a reliable source and create relevant maps using the data.			Practiced		Practiced		Practiced				
S9. Students will be able to place spatial data into a GIS database.			Practiced		Practiced		Practiced				
S10. Students will be able to make measurements of slope, aspect, and gradients using GIS tools, and they will be able to create derivative maps (e.g., drainage basins delineation, etc).			Practiced				Practiced				
Field methods:											
S11. Students will be able to produce a detailed map of a study site and place this into a GIS format.			Practiced	Practiced	Practiced		Practiced		Practiced		
S12. Students will be able to follow protocols for acquiring field data (e.g., geochemical protocols, water level sampling)			Practiced	Practiced			Practiced		Practiced		
Geochemistry skills:											
S13. Students will be able to apply concepts in interexchange equilibruim, thermodynamics, redox, solution chemistry, and organic chemistry to geochemical problems.			Practiced								
Communication and writing skills											
S14. Students will be able to write a clear and concise report using proper grammar and spelling.			Practiced		Practiced				Practiced		
S15. Students will be able to present material in a concise oral or poster format.			Practiced						Practiced		
S16. Students will be able to find and synthesize published works (library research)			Practiced						Practiced		

Learning Outcome/objective	F/Sp CHEM 1215 / 1215L (General Chemistry 1)	F/Sp CHEM 1225 / 1225L (General Chemistry 2)	F/Sp MATH 1512 (Calculus 1)	F/Sp MATH 1522 (Calculus 2)	F/Sp PHYS 1310 (Calculus-based Physics 1)	F/Sp PHYS 1320 (Calculus-based Physics 2)	F/Sp CS 151L (Computer Programming Fundamentals for non-majors)	F/Sp BIOL 1140 / 1140L (Biology for Health Science Majors)	Undergraduate Research	Brown-Bag Seminars on Careers	EPS Club	Pizza Advising Lunches	Other Undergraduate events
	SUPPORTING SCIENCES								**Extracurricular Activities**				
	4	4	4	4	3	3	3	4					
Computer Methods							Computer Methods						
Computational Methods	Computational Methods	Computational Methods	Computational Methods	Computational Methods	Computational Methods	Computational Methods	Computational Methods						

Two Year program: (does not count ENVS 1130/1130L)

	Fall	Spring
Year 1	ENVS 320L; ENVS 322L	ENVS 321L
Year 2	ENVS 315; ENVS 323L	ENVS 324; ENVS 430L

Appendix 2: [Listing of Honors Degree Recipients 2013-2020]

EPS Departmental Honors Listing

SEMESTER/YEAR	STUDENT NAMES	TOTAL #'s
Spring 2020	Brooklyn Armijo	
Summer 2020	Abigail Axness	
Summer 2020	Jade Comellas	
Summer 2020	Vishwa Patel	
Summer 2020	Sarah Rysanek	
		5
Fall 2018	Samantha Ascoli	
Fall 2018	Edward Fordham	
Spring 2019	Joseph Fuller	
Summer 2019	Jacob Helper	
Summer 2019	Patrick Kelly	
Summer 2019	Adrian Landstedt	
Fall 2018	Sean Leister	
Spring 2019	Wade Mans	
Summer 2019	Holly Olivarez	
Summer 2019	Kent Smith	
		10
Fall 2017	Alexandra Minitrez	
Summe 2018	Matthew Nellessen	
Spring 2018	Justin Norris	
Summer 2018	Dustin Perriguey	
Spring 2018	Juliet Smith	
Spring 2018	Brandon Waters	
Spring 2018	Brian Williams	
		7
Fall 2016	Jordan Anderson	
Spring 2017	Brandon Dixon	
Spring 2017	Christina Ferguson	
Spring 2017	Nicholas Freymueller	
Summer 2017	Kelly Miltenberger	
Summer 2017	Megan Mouser	
Fall 2016	Justin O'Shea	
Spring 2017	Samuel Paterniti	
Spring 2017	Amy Rosebrough	
Spring 2017	Lise Berit Rugland	
Spring 2017	Nicole Taylor	
Fall 2016	Graham Thomas	
Fall 2016	Margaret Turpin	
		13
Fall 2015	Francis Anaya	
Spring 2016	Elizabeth Davis	

Spring 2016	Alexandria Felicia	
Summer 2016	Will Ganter	
Spring 2016	Haley Garrett	
Summer 2016	Tyler Grambling	
Summer 2016	Tanner Grulke	
Spring 2016	Mariah Kelly	
Summe 2016	Elicia Ramirez	
		9
	Total over 5 years	44

Appendix 3: [EPS Assessment Plans and Assessment Reports for 2019-2020]

Part I: Cover Page
UNM Academic Programs/Unit Combined Assessment Plan and Report Template
The University of New Mexico

SECTION I-1

College, Department and Date:

College/School/Branch Campus: College of Arts and Sciences
Department: Earth and Planetary Sciences
Date: 1/14/2021
Active Plan Years (select the three year cycle that applies):
☐AY16/17-18/19 ☐AY17/18-19/20 ☐AY18/19-20/21 ☒AY19/20-21/22

Academic Program of Study:*

Degree or Certificate level: B.S. Name of the program: Earth & Planetary Sciences

Note: *Academic Program of Study is defined as an approved course of study leading to a certificate or degree reflected on a UNM transcript. A graduate-level program of study typically includes a capstone experience (e.g. thesis, dissertation, professional paper or project, comprehensive exam, etc.).*

Contact Person(s) for the Assessment Plan (include at least one name, title and email address):

- Peter Fawcett, Chair, Earth and Planetary Sciences, fawcett@unm.edu
- Gary Weissmann, Undergraduate Committee Chair, weissman@unm.edu

Dean / Associate Dean / CARC Approval Date: Click to Select Date*

* By selecting the date above, you acknowledge that your respective Dean/Associate Dean/or CARC has reviewed and approved this plan.

Part II: Assessment PLAN Body
UNM Academic Programs/Unit Combined Assessment Plan and Report Template
The University of New Mexico

SECTION II-1
Please identify at least one of your program goals:

Program Goal #1:	Students will compare the physical and chemical conditions that characterize different plate tectonic settings and apply their understanding to interpret past and present Earth environments.
Program Goal #2:	Students will identify and classify minerals and rocks, and interpret the origin and formation history of a given mineral or rock sample.
Program Goal #3:	Students will interpret the geologic history of a rock, field region or map, based on an analysis of geologic structures and/or laboratory data.
Program Goal #4:	Students will formulate a testable hypothesis based on field and/or laboratory observations, and they will devise appropriate tests of their hypotheses.
Program Goal #5:	Students will present clear and concise written and oral reviews and reports, discussing geological interpretations and problems.
Program Goal #6:	Students will describe and discuss natural hazards and natural resources in terms of geologic processes and constraints.
Program Goal #7:	Students will use professional ethical standards for reports and publications associated with collaboration, data collection, authorship, and citation of previous results.
Program Goal #8:	Students will solve geologic problems quantitatively using mathematical, chemical, and physical equations and principles.

**** If you experience column misalignment in the table below after entering your program goals, please save the file and reopen the document. It should portray accurately afterwards. ****

Please use the grid below to align your program goals to your student learning outcomes and assessment plans:

Student Learning Outcomes (SLOs) *For each row in the table, provide a SLO. If needed, add more rows. A SLO may be targeted by or aligned with more than one program goal. If a program awards more than one degree (i.e., B.S., M.A. etc.), the SLOs for graduate and undergraduate must be different. Graduate degree SLOs must be different (Master ≠ Doctorate).* *For additional guidance on SLOs, click here.*	**Program Goal #** *Please list the Program Goal(s) that the SLOs are aligned under. Use the numbering system (1,2,3..) assigned above.*	**UNM Student Learning Goals** *Check as appropriate:* *K=Knowledge;* *S=Skills;* *R=Responsibility*			**Assessment Measures** *Provide a description of the assessment instrument used to measure the SLO.* *For additional guidance on assessment measures, click here.*	**Performance Benchmark** *What is the program's benchmark (quantitative goal/criteria of success for each given assessment measure)? State the program's "criteria for success" or performance benchmark target for successfully meeting the SLO (i.e., At least 70% of the students will pass the assessment with a score of 70 or higher.)*	**Student Population(s)** *Describe the sampled population, including the total number of students and classes assessed. See note below.*
Students will compare the physical and chemical conditions that characterize different plate tectonic settings and apply their understanding to interpret past and present Earth environments.	1	K ☒	S ☒	R ☐	**EPS 303L:** Students will demonstrate their understanding of the plate tectonic control of environments important to the formation of igneous and metamorphic rocks in questions they will be asked in exams.	**EPS 303L:** 80% of the students will score >75% on exam questions related to this SLO.	All EPS BS and BA students complete EPS 303L and are assessed (typically between 9-2 students)
					EPS 304L: Students will be able to identify depositional subenvironments and plate tectonic position of several sedimentary basin types.	**EPS 304L:** over 75% of the students will score >85% on this exercise	All EPS BS and BA students complete EPS 304L and are assessed (typically between 9-2 students)
Students will identify and classify minerals and rocks, and interpret the origin and formation history of a given mineral or rock sample.	2	K ☒	S ☒	R ☐	**EPS 303L:** Students demonstrate their ability to identify and interpret the origin of igneous and metamorphic rocks by preparing a written report that synthesizes observations made on a field	**EPS 303L:** The expectation is that 80% of the students will score ≥80% the laboratory reports and the Estadio Canyon field and laboratory report.	All EPS BS and BA students complete EPS 303L and are assessed (typically between 9-2 students)

					trip to Estadio Canyon with a laboratory exercise. The assignment involves field identification of different rock types backed up by laboratory thin section analysis of the petrographic textures of rocks and the mineral assemblages present. observations made on a field trip.		
					EPS 304L: Students identify and interpret sedimentary rocks in several exercises and lab activities.	**EPS 304L:** over 75% of the students will score >80% on activities related to classification and interpretation of sedimentary rocks.	All EPS BS and BA students complete EPS 304L and are assessed (typically between 9-2 students)
					EPS 319: Students create unit descriptions of rock units in two field areas.	**EPS 319:** 75% of the students will get a score of B- or better on the assignments.	All EPS BS students complete EPS 319 and are assessed (typically between 9-20 student
Students will interpret the geologic history of a rock, field region or map, based on an analysis of geologic structures and/or laboratory data.	3	K ☒	S ☒	R ☐	**EPS 304L:** Students answer questions on exams related to vertical and lateral successions of sedimentary rocks.	**EPS 304L:** Over 75% of the students will score >80% on exam questions related to successions of sedimentary rocks.	All EPS BS and BA students complete EPS 304L and are assessed (typically between 9-2 students)
					EPS 307L: Students will demonstrate their understanding of the geologic history, rocks, and structures of a region via a take home map and rock interpretation exercise given as part of the final exam.	**EPS 307L:** We expect that at least 80% of the students will score ≥75% on this exercise and exam question.	All EPS BS and BA students complete EPS 307L and are assessed (typically between 9-2 students)
					EPS 319: Students created maps and cross sections of the two field areas including interpretations of structure and geologic history of the areas. The second area is more complex (remotely, COVID).	**EPS 319:** We expect that 75% of the students will get a score of B- or better on the assignments.	All EPS BS students complete EPS 319 and are assessed (typically between 9-20 student

Students will formulate a testable hypothesis based on field and/or laboratory observations, and they will devise appropriate tests of their hypotheses.	4	K ☒	S ☒	R ☐	**EPS 304L:** Students produce testable hypotheses in several lab activities.	**EPS 304L:** Over 75% of the students score an average of >80% on activities related to building hypotheses.	All EPS BS and BA students complete EPS 304L and are assessed (typically between 9-2 students)
					EPS 319: Students created daily research plans for the final project in which they laid out a proposed path (marked on an air photo) that they would take during the next day as if they were walking in the field (not possible with COVID). The plans must include a hypothesis about the geology they would expect to find. Hypotheses were based on previously collected data.	**EPS 319:** 75% of the students will get a score of B- or better on the assignment.	All EPS BS students complete EPS 319 and are assessed (typically between 9-20 student
Students will present clear and concise written and oral reviews and reports, discussing geological interpretations and problems.	5	K ☐	S ☒	R ☒	**EPS 304L:** Students compiled websites describing sedimentary facies	**EPS 304L:** Over 75% of the students will score an average of >80% for the website project.	All EPS BS and BA students complete EPS 304L and are assessed (typically between 9-2 students)
					EPS 319: Students created written reports that explained their understanding of the geology of 2 field areas and took detailed notes on their findings as they moved through the final project. These notes included information on their GIS analyses.	**EPS 319:** 75% of the students will get a score of B- or better on the assignments.	All EPS BS students complete EPS 319 and are assessed (typically between 9-20 student

Students will describe and discuss natural hazards and natural resources in terms of geologic processes and constraints.	6	K ☒	S ☒	R ☒	**EPS 319:** Students measured movement of an active earthflow and identified fault scarps on the flow. They identified potential risks posed to nearby structures. Students mapped and identified faults cutting late Pleistocene to Holocene surficial deposits and identified hazards associated with faults and surficial processes.	**EPS 319:** 75% of the students will get a score of B- or better on the assignments.	All EPS BS students complete EPS 319 and are assessed (typically between 9-20 student
Students will use professional ethical standards for reports and publications associated with collaboration, data collection, authorship, and citation of previous results.	7	K ☐	S ☐	R ☒	**EPS 304L:** proper citation will be used in all presentations (e.g., website project)	**EPS 304L:** Over 80% of the students will practice proper citation in their reports and website presentations.	All EPS BS and BA students complete EPS 304L and are assessed (typically between 9-2 students)
Students will solve geologic problems quantitatively using mathematical, chemical, and physical equations and principles	8	K ☒	S ☒	R ☐	**EPS 319:** Students used the "three-point problem" method to calculate dip of tilted bedding in several projects. The final three-point problem was graded independently and used as an assessment. Students also conducted remote sensing/spatial analysis evaluation of sites.	**EPS 319:** 75% of the students will get a score of B- or better on the assignments.	All EPS BS students complete EPS 319 and are assessed (typically between 9-20 student

SECTION II-2

NOTE: State explicitly whether the program's assessment will include evidence from **all** students in the program or a **sample** (by student, by course secti by milestone). When possible, it is best to study the entire population of students in your program. However, in larger programs it may be more pragmat to study a sample of the students instead. If sampling, please describe the course sections and/or the milestones. If you have questions about appropriat sampling, please contact your unit's assessment representative or the Office of Assessment at assess@unm.edu or (505) 277-4130.

Please use the area below to elaborate on your assessment plans.

Assessing and analyzing student learning outcomes:

a. Please describe the student artifact/performance that you will use to gather your assessment data:

   We use a variety of data to complete our assessments. Artifacts are not collected; however, student activity and grades on various projects that pertain to each SLO are evaluated and used for the assessments. Additionally, field survey reports completed for EPS 319 are used for much of this assessment.

b. Does your program assess all SLOs every year, or are they assessed on a staggered, three-year cycle? If staggered, please describe which SLOs will be assessed for each year. If a table better describes your response, insert it here.

   We attempt to assess all SLOs each year, though this program assessment needs significant revision and updating.

c. What is the process you will use to review, analyze and interpret your assessment data?

   The chair of the Undergraduate Committee compiles data from faculty members who teach the final classes in the program (e.g., EPS 319) for each SLO. These data are compiled into this report. The report is presented to the Department faculty at a faculty meeting, where we discuss possible changes that can be made if we are not meeting some SLOs.

   In the near future, we hope to revise the curriculum and assessment procedure for the EPS degrees (BA and BS). This will change the process reported here.

d. What is the process you will use to communicate and implement your assessment results?
   Assessment results are published and sent to each of the faculty members in the Department. Additionally, these results are sent to the College or Arts and Sciences Assessment Office.

Part III: Assessment REPORT Body
UNM Academic Programs/Unit Combined Assessment Plan and Report Template
The University of New Mexico

SECTION III-1

In response to last year's assessment report, please:

a. Describe the program changes that were implemented.
   - After assessment last year, we recognized that the EPS curriculum needs revision. However, loss of faculty due to retirements and incorporation of new faculty into the program has delayed starting this process. Discussions have begun on building new SLOs for the degree program, and some of those changes are reflected in the SLOs reported here.

b. Describe any revisions to your assessment process that were made for this reporting cycle.
   - The revised SLOs were assess in this year.
   - COVID complications made assessing students in EPS 319 and other classes difficult last year. This report contains as complete an assessment as was possible under these conditions. For some SLOs, we used student activities of seniors in Fall 2019 courses (e.g., EPS 304L).

Please use the grid and narrative responses below to discuss your assessment results from this year:

Part III: Assessment REPORT Body
UNM Academic Programs/Unit Combined Assessment Plan and Report Template

The University of New MexicoSLOs (copy and paste from PLAN above) *Copy and paste your SLOs from your entries in the PLAN above that were **measured during this year**.*	**Student Population** *Describe the sampled population, including the total number of students and classes assessed.*	**Results*** *State whether the performance benchmark was met, not met, or exceeded AND tl total number of students assessed (i.e., Exceeded, 95 out of 111 (86%) students)*
1. Students will compare the physical and chemical conditions that characterize different plate tectonic settings and apply their understanding to interpret past and present Earth environments.	EPS 303L: Not assessed this year due to COVID challenges	
	EPS 304L: 27 students assessed	27/27 (100%) scored >80% on the depositional environments exercise (scoring may have been too easy since this was an early semester exercise
2. Students will identify and classify minerals and rocks, and interpret the origin and formation history of a given mineral or rock sample.	EPS 303L: Not assessed this year due to COVID challenges.	
	EPS 304L: 27 students assessed	20/27 (74%) scored >80% on several exercises identifying and interpreting sedimentary rocks.

	EPS 319: 16 students assessed	Because of COVID restrictions, students did not conduct in-person fieldwork. Instead, students analyzed multispectral aerial drone imagery a well as digital elevation models along with hand samples and videos collected in the field by instructors to infer rock type from erosional characteristics. This SLO was assessed by the instructors in two ways: Overall scores on the two exercises and specific activities within the exercises related to rock/mineral identification and interpretation: Overall on exercises: • exercise 1: 14/16 (86%) met expectations • exercise 2: 11/16 (69%) met expectations • overall: 78% met expectations, but not clearly Specific portions of exercises: • exercise 1: 10/16 (63%) met expectations • exercise 2: 6/16 (38%) met expectations We did not meet the benchmarks for this SLO, but we note this was hard t evaluate under the COVID restrictions.
3. Students will interpret the geologic history of a rock, field region or map, based on an analysis of geologic structures and/or laboratory data.	EPS 304L: 27 students assessed	23/27 (85%) scored >80% on exam questions related to vertical and latera successions of facies interpreted from maps and imagery.
	EPS 307L: Not assessed this year due to COVID challenges.	
	EPS 319: 16 students assessed	For the four projects assessed, students generally met this benchmark (e.g 75%, 75%, 63%, and 81%, respectively).
4. Students will formulate a testable hypothesis based on field and/or laboratory observations, and they will	EPS 304L: 27 students assessed	13/27 (48%) scored >80% on exercises related to hypothesis building (this measure was not very accurately evaluated, however)
	EPS 319: 16 students assessed	13/16 (81%) of the students met expectations, so this benchmark was me

devise appropriate tests of their hypotheses.		
5. Students will present clear and concise written and oral reviews and reports, discussing geological interpretations and problems.	EPS 304L: 27 students assessed	26/27 (96% scored >80% on the facies model website exercise.
	EPS 319: 16 students assessed	Two assignments were assessed for this: 1. 13/16 met expectations (81%) 2. 8/16 met expectations (50%). This was largely due to students failing to document their GIS analyses in their notes. Overall, we did not meet this benchmark.
6. Students will describe and discuss natural hazards and natural resources in terms of geologic processes and constraints.	EPS 319: 16 students assessed	13/16 (81%) met expectations, so we met the benchmark for this SLO.
7. Students will use professional ethical standards for reports and publications associated with collaboration, data collection, authorship, and citation of previous results.	EPS 304L: 27 students assessed	26/27 (96%) used proper citation on the facies model website exercise.
8. Students will solve geologic problems quantitatively using mathematical, chemical, and physical equations and principles	EPS 319: 16 students assessed	13/16 (81%) met expectations, so we met the benchmark for this SLO

NOTE: An asterisk (*) denotes that relevant data/evidence must be included for that column (refer to the "Annual Assessment Cycle Process" diagram for guidance). Evidence associated with program improvements/changes that are actually made or implemented have to be provided the next academic year/assessment period.

Please use the area below to elaborate on your findings.

In EPS 319, most students experienced significant challenges to learning as a result of COVID-19 restrictions on meeting in person and limited time to learn the complex GIS software used for our major "field-based" projects. We graded projects using standard rubrics and to account for the added challenges of the course, we set our performance benchmark to 73%, for which we assigned a letter grade of B-. This threshold is similar to the threshold used by some other instructors in years past.

Please identify the SLOs that did not meet your benchmark defined in the Assessment Plan. Elaborate on what you think contributed to this:

The SLOs not met in 2020 were SLOs #2, 4 and 5, with some variance between different classes. In EPS 319, students had a very difficult time identifying the requisite characteristics of rocks from hand sample photos, outcrop photos and air photos. Using photos as opposed identifying rocks in person is a skill that is not commonly taught in other EPS core classes. If we teach EPS 319L in a completely remote format again, more practice activities will be needed to provide students with additional opportunities to identify important characteristics of rocks and mappable units using photos before the major projects commence.

In order to consistently meet SLO #4, hypothesis development and testing skills needs to be taught in earlier courses in the EPS curriculum.

Additionally, the EPS majors are not commonly introduced to GIS software and notetaking as they conduct GIS analyses. This led to limited success in keeping notes while conducting their work, and failing to meet expectations for SLO #5.

SECTION III-2

In response to <u>this assessment report</u>, please answer the following questions:

a. Who participated in the assessment process (the gathering of evidence, the analysis/interpretation, recommendations)?
   - Faculty who teach core classes where programmatic assessment is completed (e.g., EPS 319; EPS 304L; EPS 307L) gather the evidence and assess whether students met the benchmarks.
   - The chair of the Department Undergraduate Committee collects these data and compiles it into this document. This document is then presented at a faculty meeting.
   - During the faculty meeting, the faculty discuss the results and make recommendations for improvement, if needed.

b. Data Analysis: *Describe strengths and/or weaknesses of each SLO in students' learning/performance based on the data results you provided in the table above (e.g., Even though the benchmark was met, 40% of the students struggled with Topic X …).*

- More robust measures for assessing each SLO may be needed; however, due to COVID restrictions and difficulties this may not be able to be accomplished in the coming year (e.g., the spring semester is fully online again and the faculty member who is teaching both senior-level courses (ENVS 324 and ENVS 430L) may not have the time to devote to this task, especially since he has young children at home).

c. Based on your assessment results from this year and last year, describe the recommendation that you have for improvement:

- Describe any program changes (e.g., curriculum, instruction, etc.) that will be implemented.
  - Through this assessment (especially for EPS 319), several additional deficiencies were noted that may need to be incorporated into the EPS curriculum. These include:

    1) Many students are deficient in computer skills and beyond a basic understanding of how to turn a computer on and off many are computer illiterate. This deficiency needs to be addressed in our curriculum.

    2) Many students are deficient in 3-dimensional reasoning and visualization. This skill set has always been critical to geologic mapping but becomes even more so in the absence of the ability of doing hands on in the field mapping. The problem is that this deficiency goes beyond just problems that we experienced with EPS 319. Much of the type of work and research that these students will do in the future will be computer based. If they cannot think in 3-dimensions, they will be at a great disadvantage in their professional careers. Our curriculum needs to be adjusted to deal with this weakness.

    3) High-level thinking is deficient in this student subset. A handful of our students in the class are able to reason though geologic problems proficiently. However, the majority are deficient in this area and need to be handheld through the process of geologic mapping. Though EPS 319 is the primary class that teaches geologic mapping, these students are in the capstone course in their senior year in the program and need more practice earlier in the curriculum.

- Describe any revisions to your assessment process that will be made for the next reporting cycle.
  - Clearly, the EPS curriculum needs revision. However, COVID restrictions and introduction of new faculty members into the department are slowing down updating the curriculum. We expect to update the curriculum, however, in the next few years.

d. How, when, and to whom will results and recommendations be communicated in a meaningful way?
    - The assessment results will be communicated to the faculty at a faculty meeting on January 20.

Part I: Cover Page
UNM Academic Programs/Unit Combined Assessment Plan and Report Template
The University of New Mexico

SECTION I-1

College, Department and Date:

College/School/Branch Campus: College of Arts and Sciences
Department: Earth and Planetary Sciences
Date: 1/14/2021
Active Plan Years (select the three year cycle that applies):
☐AY16/17-18/19 ☐AY17/18-19/20 ☐AY18/19-20/21 ☒AY19/20-21/22

Academic Program of Study:*

Degree or Certificate level: B.A. Name of the program: Earth & Planetary Sciences

Note: *Academic Program of Study is defined as an approved course of study leading to a certificate or degree reflected on a UNM transcript. A graduate-level program of study typically includes a capstone experience (e.g. thesis, dissertation, professional paper or project, comprehensive exam, etc.).*

Contact Person(s) for the Assessment Plan (include at least one name, title and email address):

- Peter Fawcett, Chair, Earth and Planetary Sciences, fawcett@unm.edu
- Gary Weissmann, Undergraduate Committee Chair, weissman@unm.edu

Dean / Associate Dean / CARC Approval Date: Click to Select Date*

* By selecting the date above, you acknowledge that your respective Dean/Associate Dean/or CARC has reviewed and approved this plan.

Part II: Assessment PLAN Body
UNM Academic Programs/Unit Combined Assessment Plan and Report Template
The University of New Mexico

SECTION II-1
Please identify at least one of your program goals:

Program Goal #1:	Students will compare the physical and chemical conditions that characterize different plate tectonic settings and apply their understanding to interpret past and present Earth environments.
Program Goal #2:	Students will identify and classify minerals and rocks, and interpret the origin and formation history of a given mineral or rock sample.
Program Goal #3:	Students will interpret the geologic history of a rock, field region or map, based on an analysis of geologic structures and/or laboratory data.
Program Goal #4:	Students will formulate a testable hypothesis based on field and/or laboratory observations, and they will devise appropriate tests of their hypotheses.
Program Goal #5:	Students will present clear and concise written and oral reviews and reports, discussing geological interpretations and problems.
Program Goal #6:	Students will describe and discuss natural hazards and natural resources in terms of geologic processes and constraints.
Program Goal #7:	Students will use professional ethical standards for reports and publications associated with collaboration, data collection, authorship, and citation of previous results.

**** If you experience column misalignment in the table below after entering your program goals, please save the file and reopen the document. It should portray accurately afterwards. ****

Please use the grid below to align your program goals to your student learning outcomes and assessment plans:

Student Learning Outcomes (SLOs) *For each row in the table, provide a SLO. If needed, add more rows. A SLO may be targeted by or aligned with more than one program goal. If a program awards more than one degree (i.e., B.S., M.A. etc.), the SLOs for graduate and undergraduate must be different. Graduate degree SLOs must be different (Master ≠ Doctorate).* *For additional guidance on SLOs, click here.*	**Program Goal #** *Please list the Program Goal(s) that the SLOs are aligned under. Use the numbering system (1,2,3..) assigned above.*	**UNM Student Learning Goals** *Check as appropriate:* *K=Knowledge;* *S=Skills;* *R=Responsibility*			**Assessment Measures** *Provide a description of the assessment instrument used to measure the SLO.* *For additional guidance on assessment measures, click here.*	**Performance Benchmark** *What is the program's benchmark (quantitative goal/criteria of success for each given assessment measure)? State the program's "criteria for success" or performance benchmark target for successfully meeting the SLO (i.e., At least 70% of the students will pass the assessment with a score of 70 or higher.)*	**Student Population(s)** *Describe the sampled population, including the total number of students and classes assessed. See note below.*
Students will compare the physical and chemical conditions that characterize different plate tectonic settings and apply their understanding to interpret past and present Earth environments.	1	K ☒	S ☒	R ☐	**EPS 303L:** Students will demonstrate their understanding of the plate tectonic control of environments important to the formation of igneous and metamorphic rocks in questions they will be asked in exams.	**EPS 303L:** 80% of the students will score >75% on exam questions related to this SLO.	All EPS BS and BA students complete EPS 303L and are assessed (typically between 9-2 students)
					EPS 304L: Students will be able to identify depositional subenvironments and plate tectonic position of several sedimentary basin types.	**EPS 304L:** over 75% of the students will score >85% on this exercise	All EPS BS and BA students complete EPS 304L and are assessed (typically between 9-2 students)
Students will identify and classify minerals and rocks, and interpret the origin and formation history of a given mineral or rock sample.	2	K ☒	S ☒	R ☐	**EPS 303L:** Students demonstrate their ability to identify and interpret the origin of igneous and metamorphic rocks by preparing a written report that synthesizes observations made on a field	**EPS 303L:** The expectation is that 80% of the students will score ≥80% the laboratory reports and the Estadio Canyon field and laboratory report.	All EPS BS and BA students complete EPS 303L and are assessed (typically between 9-2 students)

					trip to Estadio Canyon with a laboratory exercise. The assignment involves field identification of different rock types backed up by laboratory thin section analysis of the petrographic textures of rocks and the mineral assemblages present. Observations are made on a field trip.		
					EPS 304L: Students identify and interpret sedimentary rocks in several exercises and lab activities.	**EPS 304L:** over 75% of the students will score >80% on activities related to classification and interpretation of sedimentary rocks.	All EPS BS and BA students complete EPS 304L and are assessed (typically between 9-2 students)
Students will interpret the geologic history of a rock, field region or map, based on an analysis of geologic structures and/or laboratory data.	3	K ☒	S ☒	R ☐	**EPS 304L:** Students answer questions on exams related to vertical and lateral successions of sedimentary rocks.	**EPS 304L:** Over 75% of the students will score >80% on exam questions related to successions of sedimentary rocks.	All EPS BS and BA students complete EPS 304L and are assessed (typically between 9-2 students)
					EPS 307L: Students will demonstrate their understanding of the geologic history, rocks, and structures of a region via a take home map and rock interpretation exercise given as part of the final exam.	**EPS 307L:** We expect that at least 80% of the students will score ≥75% on this exercise and exam question.	All EPS BS and BA students complete EPS 307L and are assessed (typically between 9-2 students)
Students will formulate a testable hypothesis based on field and/or laboratory observations, and they will devise appropriate tests of their hypotheses.	4	K ☒	S ☒	R ☐	**EPS 304L:** Students produce testable hypotheses in several lab activities.	**EPS 304L:** Over 75% of the students score an average of >80% on activities related to building hypotheses.	All EPS BS and BA students complete EPS 304L and are assessed (typically between 9-2 students)

Students will present clear and concise written and oral reviews and reports, discussing geological interpretations and problems.	5	K ☐	S ☒	R ☒	**EPS 304L:** Students compiled websites describing sedimentary facies	**EPS 304L:** Over 75% of the students will score an average of >80% for the website project.	All EPS BS and BA students complete EPS 304L and are assessed (typically between 9-2 students)
Students will describe and discuss natural hazards and natural resources in terms of geologic processes and constraints.	6	K ☒	S ☒	R ☒	We currently do not have a plan for evaluating this SLO.		
Students will use professional ethical standards for reports and publications associated with collaboration, data collection, authorship, and citation of previous results.	7	K ☐	S ☐	R ☒	**EPS 304L:** proper citation will be used in all presentations (e.g., website project)	**EPS 304L:** Over 80% of the students will practice proper citation in their reports and website presentations.	All EPS BS and BA students complete EPS 304L and are assessed (typically between 9-2 students)

SECTION II-2

NOTE: State explicitly whether the program's assessment will include evidence from **all** students in the program or a **sample** (by student, by course secti by milestone). When possible, it is best to study the entire population of students in your program. However, in larger programs it may be more pragmat to study a sample of the students instead. If sampling, please describe the course sections and/or the milestones. If you have questions about appropriat sampling, please contact your unit's assessment representative or the Office of Assessment at assess@unm.edu or (505) 277-4130.

Please use the area below to elaborate on your assessment plans.

Assessing and analyzing student learning outcomes:

e. Please describe the student artifact/performance that you will use to gather your assessment data:

We use a variety of data to complete our assessments. Artifacts are not collected; however, student activity and grades on various projects that pertain to each SLO are evaluated and used for the assessments. Additionally, field survey reports completed for EPS 319 are used for much of this assessment.

f. Does your program assess all SLOs every year, or are they assessed on a staggered, three-year cycle? If staggered, please describe which SLOs will be assessed for each year. If a table better describes your response, insert it here.

We attempt to assess all SLOs each year, though this program assessment needs significant revision and updating.

g. What is the process you will use to review, analyze and interpret your assessment data?

The chair of the Undergraduate Committee compiles data from faculty members who teach the final classes in the program (e.g., EPS 319, EPS 307L, and EPS 304L) for each SLO. These data are compiled into this report. The report is presented to the Department faculty at a faculty meeting, where we discuss possible changes that can be made if we are not meeting some SLOs.

In the near future, we hope to revise the curriculum and assessment procedure for the EPS degrees (BA and BS). This will change the process reported here.

h. What is the process you will use to communicate and implement your assessment results?
Assessment results are published and sent to each of the faculty members in the Department. Additionally, these results are sent to the College or Arts and Sciences Assessment Office.

Part III: Assessment REPORT Body
UNM Academic Programs/Unit Combined Assessment Plan and Report Template
The University of New Mexico

SECTION III-1

In response to last year's assessment report, please:

e. Describe the program changes that were implemented.

- After assessment last year, we recognized that the EPS curriculum needs revision. However, loss of faculty due to retirements and incorporation of new faculty into the program has delayed starting this process. Discussions have begun on building new SLOs for the degree program, and some of those changes are reflected in the SLOs reported here.

f. Describe any revisions to your assessment process that were made for this reporting cycle.

- The revised SLOs were assess in this year.
- COVID complications made assessing students in EPS 319 and other classes difficult last year. This report contains as complete an assessment as was possible under these conditions. For some SLOs, we used student activities of seniors in Fall 2019 courses (e.g., EPS 304L).

Please use the grid and narrative responses below to discuss your assessment results from this year:

Part III: Assessment REPORT Body
UNM Academic Programs/Unit Combined Assessment Plan and Report Template

The University of New MexicoSLOs (copy and paste from PLAN above) *Copy and paste your SLOs from your entries in the PLAN above that were **measured during this year**.*	**Student Population** *Describe the sampled population, including the total number of students and classes assessed.*	**Results*** *State whether the performance benchmark was met, not met, or exceeded AND tl total number of students assessed (i.e., Exceeded, 95 out of 111 (86%) students)*
1. Students will compare the physical and chemical conditions that characterize different plate tectonic settings and apply their understanding to interpret past and present Earth environments.	EPS 303L: Not assessed this year due to COVID challenges	
	EPS 304L: 27 students assessed	Met: 27/27 (100%) scored >80% on the depositional environments exerci (scoring may have been too easy since this was an early semester exercise
2. Students will identify and classify minerals and rocks, and interpret the origin and formation history of a given mineral or rock sample.	EPS 303L: Not assessed this year due to COVID challenges.	
	EPS 304L: 27 students assessed	Not met: 20/27 (74%) scored >80% on several exercises identifying and interpreting sedimentary rocks.
3. Students will interpret the geologic history of a rock, field region or map, based on an analysis of geologic structures and/or laboratory data.	EPS 304L: 27 students assessed	Met: 23/27 (85%) scored >80% on exam questions related to vertical and lateral successions of facies interpreted from maps and imagery.
	EPS 307L: Not assessed this year due to COVID challenges.	
4. Students will formulate a testable hypothesis based on field and/or laboratory observations, and they will devise appropriate tests of their hypotheses.	EPS 304L: 27 students assessed	Not met: 13/27 (48%) scored >80% on exercises related to hypothesis building (this measure was not very accurately evaluated, however)

5. Students will present clear and concise written and oral reviews and reports, discussing geological interpretations and problems.	EPS 304L: 27 students assessed	Met: 26/27 (96% scored >80% on the facies model website exercise.
6. Students will describe and discuss natural hazards and natural resources in terms of geologic processes and constraints.	We currently do not have a plan for evaluating this SLO.	
7. Students will use professional ethical standards for reports and publications associated with collaboration, data collection, authorship, and citation of previous results.	EPS 304L: 27 students assessed	Met: 26/27 (96%) used proper citation on the facies model website exercise.

NOTE: An asterisk (*) denotes that relevant data/evidence must be included for that column (refer to the "Annual Assessment Cycle Process" diagram for guidance). Evidence associated with program improvements/changes that are actually made or implemented have to be provided the next academic year/assessment period.

Please use the area below to elaborate on your findings.

- We do not currently have plans for evaluating SLO #6. The Department needs to determine where in our current curriculum this topic can be covered and assessed (possibly in EPS 310). As we revise the EPS curriculum in the future, this SLO will be more fully incorporated.
- COVID restrictions had a significant impact on delivering material related to these SLOs and evaluating student achievement of the SLOs. Most classes used to evaluate the SLOs are taught in Spring semester, and the disruption of shift to online teaching caused assessment to take a back-burner to delivery of material. Since Spring 2021 is also going to be taught online, we expect similar difficulties to occur next year with assessment.

Please identify the SLOs that did not meet your benchmark defined in the Assessment Plan. Elaborate on what you think contributed to this:

- SLO 2 was not met, though we missed by one percentage point. We may need to build more robust measures on this, and other, SLOs.

- SLO 4 was not met by a large margin. Part of this may be the measures we used for assessing the SLO, but also this was measured on seniors in Fall semester and the course used for assessing this SLO in Spring semester was not able to complete assessment due to COVID restrictions and difficulties.
- All SLOs need to be evaluated to be sure assessment tools are robust. This may not happen in the coming year due to COVID difficulties.

SECTION III-2

In response to <u>this assessment report</u>, please answer the following questions:

c. Who participated in the assessment process (the gathering of evidence, the analysis/interpretation, recommendations)?
   - Faculty who teach core classes where programmatic assessment is completed (e.g., EPS 319; EPS 304L; EPS 307L) gather the evidence and assess whether students met the benchmarks.
   - The chair of the Department Undergraduate Committee collects these data and compiles it into this document. This document is then presented at a faculty meeting.
   - During the faculty meeting, the faculty discuss the results and make recommendations for improvement, if needed.

d. Data Analysis: *Describe strengths and/or weaknesses of each SLO in students' learning/performance based on the data results you provided in the table above (e.g., Even though the benchmark was met, 40% of the students struggled with Topic X …).*

   - As noted above, more robust measures for assessing each SLO may be needed; however, due to COVID restrictions and difficulties this may not be able to be accomplished in the coming year (e.g., both fall and spring semesters are fully online again).

g. Based on your assessment results from <u>this year and last year</u>, describe the recommendation that you have for improvement:

   - Describe any program changes (e.g., curriculum, instruction, etc.) that will be implemented.
     - Some discussions have begun on curriculum revision in the EPS degree programs; however, due to COVID restrictions, we do not expect this to happen in the upcoming year.
     - New faculty are teaching several courses that provide data for this assessment, so they will be developing new measures in the coming year to assess the SLOs (assuming they have time to accomplish this while developing materials).

- Describe any revisions to your assessment process that will be made for the next reporting cycle.
    - We will discuss possible ways to evaluate the two SLOs that currently have no tools for assessment and try to develop measures for assessing these SLOs.

h. How, when, and to whom will results and recommendations be communicated in a meaningful way?
    - The assessment results will be communicated to the faculty at a faculty meeting on January 20.

Part I: Cover Page
UNM Academic Programs/Unit Combined Assessment Plan and Report Template
The University of New Mexico

SECTION I-1

College, Department and Date:

College/School/Branch Campus: College of Arts and Sciences
Department: Earth and Planetary Sciences
Date: 1/14/2021
Active Plan Years (select the three year cycle that applies):
☐AY16/17-18/19 ☐AY17/18-19/20 ☐AY18/19-20/21 ☒AY19/20-21/22

Academic Program of Study:*

Degree or Certificate level: B.S. Name of the program: Environmental Sciences

Note: *Academic Program of Study is defined as an approved course of study leading to a certificate or degree reflected on a UNM transcript. A graduate-level program of study typically includes a capstone experience (e.g. thesis, dissertation, professional paper or project, comprehensive exam, etc.).*

Contact Person(s) for the Assessment Plan (include at least one name, title and email address):

- Peter Fawcett, Chair, Earth and Planetary Sciences, fawcett@unm.edu
- Gary Weissmann, Undergraduate Committee Chair, weissman@unm.edu

Dean / Associate Dean / CARC Approval Date: Click to Select Date*

* By selecting the date above, you acknowledge that your respective Dean/Associate Dean/or CARC has reviewed and approved this plan.

Part II: Assessment PLAN Body
UNM Academic Programs/Unit Combined Assessment Plan and Report Template
The University of New Mexico

SECTION II-1
Please identify at least one of your program goals:

Program Goal #1:	Content Mastery Goals: Students will evaluate Earth processes that occur within and between different spheres in the Earth system (atmosphere, hydrosphere, biosphere, and geosphere)
Program Goal #2:	Skill Mastery Goals: Students will construct and test hypotheses using modern scientific equipment and/or appropriate quantitative methods
Program Goal #3:	Communication Skill Goal: Students will effectively present scientific data and arguments in oral and written formats
Program Goal #4:	Scientific Integrity Goal: Students will conduct scientific work according to ethical and professional standards.
Program Goal #5:	Career Preparation Goal: A majority of the Environmental Sciences students (75%) will participate in career preparation activities

**** If you experience column misalignment in the table below after entering your program goals, please save the file and reopen the document. It should portray accurately afterwards. ****

Please use the grid below to align your program goals to your student learning outcomes and assessment plans:

Student Learning Outcomes (SLOs) *For each row in the table, provide a SLO. If needed, add more rows. A SLO may be targeted by or aligned with more than one program goal. If a program awards more than one degree (i.e., B.S., M.A. etc.), the SLOs for graduate and undergraduate must be different. Graduate degree SLOs must be different (Master ≠ Doctorate).* *For additional guidance on SLOs, click here.*	**Program Goal #** *Please list the Program Goal(s) that the SLOs are aligned under. Use the numbering system (1,2,3..) assigned above.*	**UNM Student Learning Goals** *Check as appropriate:* *K=Knowledge;* *S=Skills;* *R=Responsibility*			**Assessment Measures** *Provide a description of the assessment instrument used to measure the SLO.* *For additional guidance on assessment measures, click here.*	**Performance Benchmark** *What is the program's benchmark (quantitative goal/criteria of success for each given assessment measure)? State the program's "criteria for success" or performance benchmark target for successfully meeting the SLO (i.e., At least 70% of the students will pass the assessment with a score of 70 or higher.)*	**Student Population(s)** *Describe the sampled population, including the total number of students and classes assessed. See note below.*
P1. Students will employ critical thinking skills to solve problems related to the interplay of physical, chemical, geological, atmospheric, and biological processes across the spectrum of spatial and temporal scales relevant to Earth's systems	1	K ☒	S ☒	R ☐	**ENVS 324:** Several questions on the ENVS 324 final exam will require critical thinking about interactions between Earth systems. .	**ENVS 324:** 75% of the students will score 75% or better on the exam.	**ENVS 324:** Evidence will be collected from students enrolled in ENVS 324, a required course for all majors ir ENVS. Enrollment ranges from 9-25 per year.
					ENVS 430L: Students will be assessed from development, completion, presentation and reporting of their final projects in ENVS 430L	**ENVS 430L:** At least 80% of the students will conduct projects that assess complex interactions between Earth systems.	**ENVS 430L:** Evidence will be collected from students enrolled in ENVS 430L, a required capstone course for al majors in ENVS. Enrollment ranges fro 9-25 per year.
P2. Students will apply environmental systems knowledge to solve societally relevant problems (e.g., site environmental characterization, climate change, water supply).	1	K ☒	S ☒	R ☒	**ENVS 324:** HW 5, problem 4 (quantitative problem on atmosphere)	**ENVS 324:** 75% of the students will score 100% on the problem.	**ENVS 324:** Evidence will be collected from students enrolled in ENVS 324, a required course for all majors ir ENVS. Enrollment

							ranges from 9-25 per year.
					ENVS 430L: Students will be assessed from development, completion, presentation and reporting of their final projects in ENVS 430L	**ENVS 430L:** At least 75% of the students will score >80% on their final project grade.	**ENVS 430L:** Evidence will be collected from students enrolled iin ENVS 430L, a required capstone course for al majors in ENVS. Enrollment ranges fro 9-25 per year.
P3. Students will design/test and/or evaluate scientific hypotheses.	2	K ☒	S ☒	R ☐	Students will be assessed during development of final projects in ENVS 430L	At least 75% of the studetns will be able to independently develop testable hypotheses associated with their final projects in ENVS 430L.	Evidence will be collected from studen enrolled in ENVS 430L, a required capstone course for all majors ir ENVS. Enrollment ranges from 9-25 per year.
P4. Students will apply quantitative skills to interpret environmental data (e.g., statistically analyzing and interpreting environmental science data) and/or use multiple types of data at different spatial and temporal scales (e.g., conducting and integrating field, laboratory, remote sensing and computational analysis to generate and interpret new data), evaluating the quality of the data sets they use.	2	K ☒	S ☒	R ☐	**ENVS 324:** HW 5, problem 4 (quantitative problem on atmosphere)	**ENVS 324:** 75% of the students will score 100% on the problem. .	**ENVS 324:** Evidence will be collected from students enrolled in ENVS 324, a required course for all majors ir ENVS. Enrollment ranges from 9-25 per year.
					ENVS 430L: Students will be assessed from development, completion, presentation and reporting of their final projects.	**ENVS 430L:** At least 75% of the students will be able to complete their final projects with a grade of 80% or better.	**ENVS 430L:** Evidence will be collected from students enrolled iin ENVS 430L, a required capstone course for al majors in ENVS. Enrollment ranges fro 9-25 per year.

P5. Students will present written and/or oral communication for research or education or public audiences and appropriately cite primary literature.	3	K ☐	S ☒	R ☒	**ENVS 430L:** Students will be assessed from presentation and reporting of their final projects.	**ENVS 430L:** At least 75% of the students will be able to clearly present their final projects.	**ENVS 430L:** Evidence will be collected from students enrolled in ENVS 430L, a required capstone course for al majors in ENVS. Enrollment ranges fro 9-25 per year.
P6. Students will apply scientific integrity and ethics as reflected in evidence based analysis and respectful interactions with colleagues at all education and career levels (e.g., written and verbal communication with colleagues and lawmakers; submitted journal articles, abstracts and class papers; and oral presentations).	4	K ☐	S ☐	R ☒	**ENVS 430L:** Students will be assessed from work of their final projects.	**ENVS 430L:** At least 80% of the students will use proper citations for their final projects; at least 90% of students will work effectively in their assigned groups for the project.	Evidence will be collected from studen enrolled in ENVS 430L a required capstone course for all majors ir ENVS. Enrollment ranges from 9-25 per year.
P7. A majority of the Environmental Sciences students (75%) will participate in career preparation activities.	5	K ☒	S ☒	R ☐	Students will participate in brown-bag seminars, undergraduate research, and other career prep activities.	75% of the ENVS majors will participate in these activities	BS-ENVS majors
					ENVS 430L: Presentations on career preparation, graduate school opportunities, and career planning will happen in this class.	**ENVS 430L:** 75% of students in the class will be present during these presentations.	**ENVS 430L:** Evidence will be collected from students enrolled in ENVS 430L, a required capstone course for al majors in ENVS. Enrollment ranges fro 9-25 per year.

SECTION II-2

NOTE: State explicitly whether the program's assessment will include evidence from **all** students in the program or a **sample** (by student, by course secti by milestone). When possible, it is best to study the entire population of students in your program. However, in larger programs it may be more pragmat to study a sample of the students instead. If sampling, please describe the course sections and/or the milestones. If you have questions about appropriat sampling, please contact your unit's assessment representative or the Office of Assessment at assess@unm.edu or (505) 277-4130.

Please use the area below to elaborate on your assessment plans.

Assessing and analyzing student learning outcomes:

i. Please describe the student artifact/performance that you will use to gather your assessment data:

We use a variety of data to complete our assessments. Artifacts are not collected; however, student activity and grades on various projects that pertain to each SLO are evaluated and used for the assessments. Additionally, oral and poster presentations are completed for ENVS 430L and presented at the final departmental seminar each year (COVID prevented this from happening in Spring 2020).

j. Does your program assess all SLOs every year, or are they assessed on a staggered, three-year cycle? If staggered, please describe which SLOs will be assessed for each year. If a table better describes your response, insert it here.

We attempt to assess all SLOs each year.

k. What is the process you will use to review, analyze and interpret your assessment data?

The chair of the Undergraduate Committee compiles data from faculty members who teach the final classes in the program (e.g., ENVS 324 and ENVS 430L) for each SLO. These data are compiled into this report. The report is presented to the Department faculty at a faculty meeting, where we discuss possible changes that can be made if we are not meeting some SLOs.

In the near future, we hope to have interim assessments available in addition to the programmatic assessment. These will be discussed amongst the faculty who teach the core classes. In this way, we can make shifts to help students reach meet the SLOs, if needed.

l. What is the process you will use to communicate and implement your assessment results?
Assessment results are published and sent to each of the faculty members in the Department. Additionally, these results are sent to the College or Arts and Sciences Assessment Office.

Part III: Assessment REPORT Body
UNM Academic Programs/Unit Combined Assessment Plan and Report Template
The University of New Mexico

SECTION III-1

In response to last year's assessment report, please:

i. Describe the program changes that were implemented.

- After assessment last year, we recognized that our SLOs were too specific in some areas and were not readily assessable. Therefore, we revised our SLOs. These were approved by faculty in Fall 2019 and implemented in our courses immediately after that approval.
- The attached revised Program Matrix indicates when and how the different SLOs are introduced, practiced, and assessed (e.g., mastered). Also included in the matrix are specific skills goals; however, these are not officially assessed for the purpose of this document but instead used for internal department tracking.
- We recognized that students were having a difficult time graduating in 4 years if they found the ENVS major in their second year at UNM. Therefore, we streamlined the prerequisite structure so that the ENVS core classes could be completed in 2 years. We also adjusted the semester when several classes are taught to align with this new ENVS prerequisite structure.

j. Describe any revisions to your assessment process that were made for this reporting cycle.

- The new SLOs were assess in this year.
- We began to develop an internal assessment procedure for the ENVS degree program that tracks student work towards SLOs in ENVS core classes. We used a CARC grant to fund a student to develop an Access Database to help us track SLOs in all classes. Unfortunately with COVID complications, that work is still in progress. Our plan is to develop interim assessments to try catching areas where students need earlier interventions for successful completion of the SLOs.

Please use the grid and narrative responses below to discuss your assessment results from this year:

Part III: Assessment REPORT Body
UNM Academic Programs/Unit Combined Assessment Plan and Report Template

The University of New Mexico SLOs (copy and paste from PLAN above) *Copy and paste your SLOs from your entries in the PLAN above that were **measured during this year**.*	**Student Population** *Describe the sampled population, including the total number of students and classes assessed.*	**Results*** *State whether the performance benchmark was met, not met, or exceeded AND tl total number of students assessed (i.e., Exceeded, 95 out of 111 (86%) students)*
P1. Students will employ critical thinking skills to solve problems related to the interplay of physical, chemical, geological, atmospheric, and biological processes across the spectrum of spatial and temporal scales relevant to Earth's systems	**ENVS 324:** 8 ENVS majors	**ENVS 324:** Met, 6/8 students (75%).
	ENVS 430L: 7 ENVS majors	**ENVS 430L:** Met, 7/7 students (100%)
P2. Students will apply environmental systems knowledge to solve societally relevant problems (e.g., site environmental characterization, climate change, water supply).	**ENVS 324:** 8 ENVS majors	**ENVS 324:** Not met, 5/8 (63%) of the students.
	ENVS 430L: 7 ENVS majors	**ENVS 430L:** Met, 7/7 students (100%)
P3. Students will design/test and/or evaluate scientific hypotheses.	**ENVS 430L:** 7 ENVS majors	**ENVS 430L:** Met, 6/7 students (86%)
	ENVS 324: 8 ENVS majors	**ENVS 324:** Not met, 5/8 (63%) of the students.

P4. Students will apply quantitative skills to interpret environmental data (e.g., statistically analyzing and interpreting environmental science data) and/or use multiple types of data at different spatial and temporal scales (e.g., conducting and integrating field, laboratory, remote sensing and computational analysis to generate and interpret new data), evaluating the quality of the data sets they use.	**ENVS 430L:** 7 ENVS majors	**ENVS 430L:** Met, 7/7 students (100%)
P5. Students will present written and/or oral communication for research or education or public audiences and appropriately cite primary literature.	**ENVS 430L:** 7 ENVS majors	**ENVS 430L:** Met, 7/7 students (100%)
P6. Students will apply scientific integrity and ethics as reflected in evidence based analysis and respectful interactions with colleagues at all education and career levels (e.g., written and verbal communication with colleagues and lawmakers; submitted journal articles, abstracts and class papers; and oral presentations).	**ENVS 430L:** 7 ENVS majors	**ENVS 430L:** Met, 7/7 students (100%), but limited due to COVID restrictions.
P7. A majority of the Environmental Sciences students (75%) will participate in career preparation activities.	This SLO could not be assess for the general population of ENVS majors through seminars, etc, due to COVID restrictions late in the year.	

	ENVS 430L: 7 ENVS majors	**ENVS 430L:** Met, 7/7 students (100%), but limited due to COVID restrictions.

NOTE: An asterisk (*) denotes that relevant data/evidence must be included for that column (refer to the "Annual Assessment Cycle Process" diagram for guidance). Evidence associated with program improvements/changes that are actually made or implemented have to be provided the next academic year/assessment period.

Please use the area below to elaborate on your findings.

- Most SLOs were met in the first cohort going through our new ENVS degree program, though the number of students was small and COVID restrictions and changes made in the middle of spring semester likely had significant influence on the results.
- COVID restrictions over the past year significantly impacted our students and the faculty ability to reach and evaluate all SLOs this year. However, our new SLOs appear to be readily assessable and the assessment process was relatively smooth this year.
- Our students reached several of the informal skills goals, as well, however the students do not cover geochemistry topics in any depth and this important topic may need revision in the curriculum.

Please identify the SLOs that did not meet your benchmark defined in the Assessment Plan. Elaborate on what you think contributed to this:

- SLO P2 was not met in ENVS 324 but was met by students in the exercise for ENVS 430L. We may need to re-evaluate our assessment benchmarks to be sure they are all robust. Due to COVID difficulties, however, this may not be accomplished in the coming year since all classes are again online this spring.
- Students met all other SLOs, but again this may be due to COVID restrictions or need to build more robust evaluation tools.

SECTION III-2

In response to <u>this assessment report</u>, please answer the following questions:

e. Who participated in the assessment process (the gathering of evidence, the analysis/interpretation, recommendations)?
   - Faculty who teach core classes where programmatic assessment is completed (e.g., ENVS 324; ENVS 430L) gather the evidence and assess whether students met the benchmarks.
   - The chair of the Department Undergraduate Committee collects these data and compiles it into this document. This document is then presented at a faculty meeting.

- During the faculty meeting, the faculty discuss the results and make recommendations for improvement, if needed.

f. Data Analysis: *Describe strengths and/or weaknesses of each SLO in students' learning/performance based on the data results you provided in the table above (e.g., Even though the benchmark was met, 40% of the students struggled with Topic X …).*

- As noted above, more robust measures for assessing each SLO may be needed; however, due to COVID restrictions and difficulties this may not be able to be accomplished in the coming year (e.g., the spring semester is fully online again and the faculty member who is teaching both senior-level courses (ENVS 324 and ENVS 430L) may not have the time to devote to this task, especially since he has young children at home).

k. Based on your assessment results from this year and last year, describe the recommendation that you have for improvement:

- Describe any program changes (e.g., curriculum, instruction, etc.) that will be implemented.
  - Due to significant staff loss from retirements, we are in the process of cross-listing several of the ENVS classes with similar EPS classes (e.g., ENVS 323L is similar to EPS 476). To accomplish this, we are in the process of changing ENVS 323L to ENVS 423L and ENVS 324 to ENVS 424.

- Describe any revisions to your assessment process that will be made for the next reporting cycle.
  - We will continue to implement the interim assessment procedure. COVID has made progress on this slow, and it also makes additional meetings to discuss curriculum and assessment difficult.

l. How, when, and to whom will results and recommendations be communicated in a meaningful way?
- The assessment results will be communicated to the faculty at a faculty meeting on January 20.

Part I: Cover Page
UNM Academic Programs/Unit Combined Assessment Plan and Report Template
The University of New Mexico

SECTION I-1

College, Department and Date:

College/School/Branch Campus: CAS
Department: Earth and Planetary Sciences
Date: 12/11/20
Active Plan Years (select the three year cycle that applies):

☐ AY16/17-18/19 ☐ AY17/18-19/20 ☑ AY18/19-20/21 ☐ AY19/20-21/22

Academic Program of Study:*

Degree or Certificate level: M.S. Name of the program: M.S. in Earth and Planetary Sciences

Note: *Academic Program of Study is defined as an approved course of study leading to a certificate or degree reflected on a UNM transcript. A graduate-level program of study typically includes a capstone experience (e.g. thesis, dissertation, professional paper or project, comprehensive exam, etc.).*

Contact Person(s) for the Assessment Plan (include at least one name, title and email address):

- Dr. Peter Fawcett, Chair, EPS, fawcett@unm.edu
- Dr. Tobias Fischer, Chair, Graduate Committee, fischer@unm.edu
-

Dean / Associate Dean / CARC Approval Signature:

Part II: Assessment PLAN
UNM Academic Programs/Unit Combined Assessment Plan and Report Template
The University of New Mexico

SECTION II-1

Please identify at least one of your program goals:

Program Goal #1:	Broadly understand and explain the significance of major research questions in one or more areas of earth and planetary sciences.
Program Goal #2:	Formulate testable scientific hypotheses.
Program Goal #3:	Carry out independent research in one or more subfields of earth and planetary sciences, using appropriate field, experimental, analytical, and/or computational methods.
Program Goal #4:	Describe, synthesize, and interpret the results of a scientific investigation orally and in writing.
Program Goal #5:	

Need help formulating your Program Goals? Click here for additional information provided by the UNM Office of Assessment and Academic Program Review.

Please use the grid below to align your program goals to your student learning outcomes and assessment plans:

Student Learning Outcomes (SLOs) *For each row in the table, provide a SLO. If needed, add more rows. A SLO may be targeted by or aligned with more than one program goal. If a program awards more than one degree (i.e., B.S., M.A. etc.), the SLOs for graduate and undergraduate must be different. Graduate degree SLOs must be different (Master ≠ Doctorate).* *For additional guidance on SLOs, click here.*	**Program Goal #** *Please list the Program Goal(s) that the SLOs are aligned under. Use the numbering system (1,2,3..) assigned above.*	**UNM Student Learning Goals** *Check as appropriate: K=Knowledge; S=Skills; R=Responsibility*			**Assessment Measures** *Provide a description of the assessment instrument used to measure the SLO.* *For additional guidance on assessment measures, click here.*	**Performance Benchmark** *What is the program's benchmark (quantitative goal/criteria of success for each given assessment measure)? State the program's "criteria for success" or performance benchmark target for successfully meeting the SLO (i.e., At least 70% of the students will pass the assessment with a score of 70 or higher.)*	**Student Population(s)** *Describe the sampled population, including the total number of students and classes assessed. See note below.*
		K	S	R			
Students will summarize current research questions and approaches in one or more subfields in earth, atmospheric, and/or planetary science.	1	☑	☑	☐	(a) All EPS MS graduate students prepare one research proposal as part of the comprehensive examination process. Each proposal includes a description of prior work on a specific topic, a description of the research question(s) being asked, research	(a) We expect that 85% of the students taking their examinations each year will pass the oral portion of the exam. (b) We expect that 85% of the written summaries of colloquium talks will accurately identify the scientific question asked, the	Evidence will come from all graduate students who take the comprehensive examination each year and from all graduate students enrolled in EPS 501 each year.
MS students will write at one research proposal that presents a testable hypothesis, outlines the types of data needed to test the hypothesis, and describes how the collected data will be used to test the hypothesis.	2	☑	☑	☑	All MS students prepare one research proposal in their second semester in residence. Each member of a student's exam committee must provide written answers of "yes" or "no" to the following questions within one week of submission of the	We thus expect that 85% of our graduate students submitting proposals each year will pass directly to the oral exam stage without a mandatory extra committee meeting and rewriting of the proposal(s)	Evidence will come from all graduate students who take the comprehensive examination each year.
Students will read and critically evaluate primary scientific literature in one or more subfields in earth, atmospheric, and/or planetary science.	3	☐	☐	☐			

Students will devise and implement a field, experimental, analytical, and/or computational plan aimed at collecting and analyzing the data necessary to address a specific scientific question.	3	☑	☑	☑	This goal will be assessed via the written proposals described in B.1. above and during the oral portion of the comprehensive examination. The research plan is an integral part of each proposal, and is also assessed in depth during the oral examination	Success is defined as attaining an unconditional pass on the comprehensive examination. We expect that 85% of graduate students taking their comprehensive examinations each year will pass unconditionally.	Evidence will come from all graduate students who take the comprehensive examination each year.
Students will present and defend the results of their research (orally or in poster format) in order to demonstrate mastery of the material and an ability to communicate the results and significance of their work to other scientists.	4	☐	☐	☐	This goal will be assessed via records of publications, maps, abstract, and technical reports authored or coauthored by current and former graduate students that are directly related to work carried out while the students were in residence at	We define success as publication of at least one article or map, or acceptance of one professional report by 50% of our MS students within three years of completion of the degree. We expect that higher percentages of published abstracts will result at the MS	Evidence will come from all current graduate students and all students who have graduated within the last three years.
Students will write a thesis, dissertation, or collection of manuscripts in which the motivation for the research is outlined, methods are described, data and interpretations are clearly separated, prior work is appropriately referenced, and the	4	☐	☐	☐	"	"	"
		☐	☐	☐			
		☐	☐	☐			

SECTION II-2

NOTE: State explicitly whether the program's assessment will include evidence from **all** students in the program or a **sample** (by student, by course section, by milestone). When possible, it is best to study the entire population of students in your program. However, in larger programs it may be more pragmatic to study a sample of the students instead. If sampling, please describe the course sections and/or the milestones. If you have questions about appropriate sampling, please contact your unit's assessment representative or the Office of Assessment at assess@unm.edu or (505) 277-4130.

Please use the area below to elaborate on your assessment plans.

Assessing and analyzing student learning outcomes:

a. Please describe the student artifact/performance that you will use to gather your assessment data?

Two performances will be used to assess SLO 1. The first is the preparation of a research proposal as part of the comprehensive exam and the second is successfully completing our Departmental Seminar series.

b. Does your program assess all SLOs every year, or are they assessed on a staggered, three-year cycle? If staggered, please describe which SLOs will be assessed for each year. If a table better describes your response, insert it here.

A three-year cycle is used:
Year 1 - SLO 1
Year 2 - SLO 2
Year 3 - SLOs 3&4
We are in Year 1 of the cycle.

c. What is the process you will use to review, analyze and interpret your assessment data?

The preparation of a research proposal for the MS comprehensive exam and successful completion of our weekly departmental seminar will be the basis for the assessment. The comprehensive exam for M.S. students consists of a 15-page written thesis proposal in which students will outline their hypothesis, describe their plan for collecting and analyzing data, and describe potential outcomes. The written proposal is read by all committee members, and assessed for the student's ability to conduct the proposed research and objectively evaluate the results from their application of modern field, analytical, or computational methods. Thus, preparing this written research proposal is relevant for SLO

d. What is the process you will use to communicate and implement your assessment results?

Collection of assessment data is conducted by the Graduate Committee Chair (Tobias Fischer). The compiled data are discussed by the graduate committee and then shared with the entire faculty to solicit feedback the assessment results and process.

Part III: Assessment REPORT Body
UNM Academic Programs/Unit Combined Assessment Plan and Report Template
The University of New Mexico

SECTION III-1

In response to last year's assessment report, please:

a. Describe the program changes that were implemented.

There were no changes to the program since last year.

b. Describe any revisions to your assessment process that were made for this reporting cycle.

There were no changes to the assessment process.

Please use the grid and narrative responses below to discuss your assessment results from this year:

SLOs (from PLAN above) *SLOs are from your entries in the PLAN above that were **measured during this year**:*	**Student Population** *Describe the sampled population, including the total number of students and classes assessed.*	**Results*** *State whether the performance benchmark was met, not met, or exceeded AND the total number of students assessed (i.e., Exceeded, 95 out of 111 (86%) students)* *For additional guidance on reporting results, click here.*
Students will summarize current research questions and approaches in one or more subfields in earth, atmospheric, and/or planetary science.	All students who have taken the weekly departmental seminar in the past 3 years.	The performance benchmark of at least 85% passing was exceeded. 23 students took the departmental seminar in the past 3 years and 100% passed.
MS students will write at one research proposal that presents a testable hypothesis, outlines the types of data needed to test the hypothesis, and describes how the collected data will be used to test the hypothesis.	All students who have taken MS comprehensive exam in the past 3 years.	The performance benchmark of at least 85% passing was exceeded. 7 students took the MS comprehensive exam in the past 3 years and 100% passed.
Students will read and critically evaluate primary scientific literature in one or more subfields in earth, atmospheric, and/or planetary science.	not assessed this year	
Students will devise and implement a field, experimental, analytical, and/or computational plan aimed at collecting and analyzing the data necessary to address a specific scientific question.	not assessed this year	
Students will present and defend the results of their research (orally or in poster format) in order to demonstrate mastery of the material and an ability to communicate the results and significance of their work to other scientists	not assessed this year	
Students will write a thesis, dissertation, or collection of manuscripts in which the motivation for the research is outlined, methods are described, data and	not assessed this year	

SLOs (from PLAN above)	Student Population	Results*

NOTE: An asterisk (*) denotes that relevant data/evidence must be included for that column (refer to the "Annual Assessment Cycle Process" diagram for guidance). Evidence associated with program improvements/changes that are actually made or implemented have to be provided the next academic year/assessment period.

Please use the area below to elaborate on your findings.

Please identify the SLOs that did not meet your benchmark defined in the Assessment Plan. Elaborate on what you think contributed to this:

None, benchmarks were exceeded for all evaluated SLOs.

SECTION III-2

In response to <u>this assessment report</u>, please answer the following questions:

a. Who participated in the assessment process (the gathering of evidence, the analysis/interpretation, recommendations)?

The EPS Graduate Committee Chair, Tobias Fischer, led the process. EPS office staff helped gather evidence. The process and results were discussed with the Graduate Committee on December 9-11 2020.

b. Data Analysis: *Describe strengths and/or weaknesses of each SLO in students' learning/performance based on the data results you provided in the table above (e.g., Even though the benchmark was met, 40% of the students struggled with Topic X …).*

SLO 1 was exceeded during this assessment period based on the information provided above.

c. Based on your assessment results from this year and last year, describe the recommendations that you have for improvement:

- Describe any program changes (e.g., curriculum, instruction, etc.) that will be implemented.

No program changes are planned.

- Describe any revisions to your assessment process that will be made for the next reporting cycle.

No changes to the assessment process are planned.

d. How, when, and to whom will results and recommendations be communicated in a meaningful way?

The results were discussed by the graduate committee on December 9-11 2020 and communicated to the EPS chair on December 11, 2020.

DEPARTMENT OF EARTH AND PLANETARY SCIENCES

EVALUATION OF MS DEFENSE EXAMINATION – 2ND SEMESTER

STUDENT:
DEGREE: M.S.
PROPOSAL SUPERVISOR: **READER:**
TITLE:

Please rate the following aspects of each component of the examination from 1= poor to 5= excellent

Component 1: Written proposal; 1= poor to 5= excellent

1A) The written **MS** thesis summarizes and critically evaluates current research questions and approaches in one or more subfields in earth, atmospheric, and/or planetary science ① ② ③ ④ ⑤

1B) Testable hypotheses are clearly delineated in the written proposal ① ② ③ ④ ⑤

1C) The proposal represents an appropriate test of the identified hypothesis ① ② ③ ④ ⑤

Comments on the written document:

Component 2: Oral presentation; 1= poor to 5= excellent

2A) The oral presentation clearly outlined a testable hypothesis and its significance for the field of study ① ② ③ ④ ⑤

2B) The oral presentation clearly differentiated data presentation from data interpretation ① ② ③ ④ ⑤

2C) The oral presentation was comprehensible to a broad earth sciences audience ① ② ③ ④ ⑤

2D) The student's oral presentation skills demonstrated proficiency in scientific communication ① ② ③ ④ ⑤

Comments on the oral presentations:

Component 3: Research defense; 1= poor to 5= excellent

3A) The student was able to defend the concepts, results, and importance of their research and how it fits into a broader area of inquiry ① ② ③ ④ ⑤

3B) The student's research is of high enough quality to be publishable in peer reviewed journals and/or presented at professional meetings ① ② ③ ④ ⑤

3C) The student demonstrated breadth and/or depth in understanding scientific concepts ① ② ③ ④ ⑤

Comments on the question and answer period

Component 4: Overall research; 1= poor to 5= excellent

4A) The scientific research presented shows competence in implementation of research methodologies ① ② ③ ④ ⑤

4B) The student showed scientific independence and creativity in the research, developing methods, and/or new interpretive techniques suitable for the **MS** level ① ② ③ ④ ⑤

4C) The student clearly delineated the significance of their research and its impact on broader areas of inquiry ① ② ③ ④ ⑤

4D) The scientific research presented was completed in the timeline suitable for an **MS** degree program ① ② ③ ④ ⑤

Comments on the scientific quality – overall impression

Part I: Cover Page
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The University of New Mexico

SECTION I-1

College, Department and Date:

College/School/Branch Campus: CAS
Department: Earth and Planetary Sciences
Date: 12/9/20
Active Plan Years (select the three year cycle that applies):

☐ AY16/17-18/19 ☐ AY17/18-19/20 ☑ AY18/19-20/21 ☐ AY19/20-21/22

Academic Program of Study:*

Degree or Certificate level: Ph.D. Name of the program: Ph.D. in Earth and Planetary Sciences

Note: *Academic Program of Study is defined as an approved course of study leading to a certificate or degree reflected on a UNM transcript. A graduate-level program of study typically includes a capstone experience (e.g. thesis, dissertation, professional paper or project, comprehensive exam, etc.).*

Contact Person(s) for the Assessment Plan (include at least one name, title and email address):

- Dr. Peter Fawcett, Chair, Graduate Committee, fawcett@unm.edu
- Dr. Tobias Fischer, Chair, Graduate Committee, fischer@unm.edu
-

Dean / Associate Dean / CARC Approval Signature:

Part II: Assessment PLAN
UNM Academic Programs/Unit Combined Assessment Plan and Report Template
The University of New Mexico

SECTION II-1

Please identify at least one of your program goals:

Program Goal #1:	Upon graduating from the graduate program in Earth and Planetary Sciences, Ph.D. students will be able to Broadly understand and explain the significance of major research questions in one or more areas of earth and planetary sciences.
Program Goal #2:	Upon graduating from the graduate program in Earth and Planetary Sciences, Ph.D. students will be able to: Formulate testable scientific hypotheses.
Program Goal #3:	Upon graduating from the graduate program in Earth and Planetary Sciences, Ph.D. students will be able to: Carry out independent research in one or more subfields of earth and planetary sciences, using appropriate field, experimental, analytical, and/or computational methods.
Program Goal #4:	Upon graduating from the graduate program in Earth and Planetary Sciences, Ph.D. students will be able to: Describe, synthesize, and interpret the results of a scientific investigation orally and in writing.
Program Goal #5:	

Need help formulating your Program Goals? Click here for additional information provided by the UNM Office of Assessment and Academic Program Review.

Please use the grid below to align your program goals to your student learning outcomes and assessment plans:

Student Learning Outcomes (SLOs) *For each row in the table, provide a SLO. If needed, add more rows. A SLO may be targeted by or aligned with more than one program goal. If a program awards more than one degree (i.e., B.S., M.A. etc.), the SLOs for graduate and undergraduate must be different. Graduate degree SLOs must be different (Master ≠ Doctorate).* *For additional guidance on SLOs, click here.*	**Program Goal #** *Please list the Program Goal(s) that the SLOs are aligned under. Use the numbering system (1,2,3..) assigned above.*	**UNM Student Learning Goals** *Check as appropriate: K=Knowledge; S=Skills; R=Responsibility*			**Assessment Measures** *Provide a description of the assessment instrument used to measure the SLO.* *For additional guidance on assessment measures, click here.*	**Performance Benchmark** *What is the program's benchmark (quantitative goal/criteria of success for each given assessment measure)? State the program's "criteria for success" or performance benchmark target for successfully meeting the SLO (i.e., At least 70% of the students will pass the assessment with a score of 70 or higher.)*	**Student Population(s)** *Describe the sampled population, including the total number of students and classes assessed. See note below.*
		K	S	R			
Students will summarize current research questions and approaches in one or more subfields in earth, atmospheric, and/or planetary science.	1	☑	☑	☐	(a) All EPS PhD graduate students prepare two research proposals as part of the comprehensive examination process. Each proposal includes a description of prior work on a specific topic, a description of the research question(s) being asked, and	(a) We expect that 85% of the students taking their examinations each year will pass the oral portion of the exam. (b) We expect that 85% of the written summaries of colloquium talks will accurately identify the scientific question asked, the	Evidence will come from all graduate students who take the comprehensive examination each year and from all graduate students enrolled in EPS 501 each year.
PhD students will write at two research proposals that present a testable hypothesis, outline the types of data needed to test the hypothesis, and describe how the collected data will be used to test the hypothesis. They will	2	☑	☑	☑	All PhD students prepare two research proposals (each advised by different faculty members) in their third semester in residence. Each member of a student's exam committee must provide written answers of "yes" or "no" to the following questions within	We thus expect that 85% of our graduate students submitting proposals each year will pass directly to the oral exam stage without a mandatory extra committee meeting and rewriting of the proposal(s).	Evidence will come from all graduate students who take the comprehensive examination each year.
Students will read and critically evaluate primary scientific literature in one or more subfields in earth, atmospheric, and/or planetary science.	3	☐	☐	☐			

Students will devise and implement a field, experimental, analytical, and/or computational plan aimed at collecting and analyzing the data necessary to address a specific scientific question.	3	☑	☑	☑	This goal will be assessed via the written proposals described in B.1. above and during the oral portion of the comprehensive examination. The research plan is an integral part of each proposal, and is also assessed in depth during the oral examination.	Success is defined as attaining an unconditional pass on the comprehensive examination. We expect that 85% of graduate students taking their comprehensive examinations each year will pass unconditionally.	Evidence will come from all graduate students who take the comprehensive examination each year.
Students will present and defend the results of their research (orally or in poster format) in order to demonstrate mastery of the material and an ability to communicate the results and significance of their work to other scientists.	4	☐	☐	☐			
Students will write a dissertation, or collection of manuscripts in which the motivation for the research is outlined, methods are described, data and interpretations are clearly separated, prior work is appropriately referenced, and the	4	☐	☐	☐			
Students will communicate the results of research carried out independently or as part of a team via publication of peer-reviewed articles, maps, meeting abstracts, and/or technical reports. Publication is an obligation inherent in the	4	☑	☑	☑	This goal will be assessed via records of publications, maps, abstract, and technical reports authored or coauthored by current and former graduate students that are directly related to work carried out while the students were in residence at	We define success as publication of at least one article or map, or acceptance of one professional report by >75% of our PhD students within three years of completion of the degree. We expect that higher percentages of published abstracts will result at	Evidence will come from all current graduate students and all students who have graduated within the last three years.
		☐	☐	☐			

SECTION II-2

NOTE: State explicitly whether the program's assessment will include evidence from **all** students in the program or a **sample** (by student, by course section, by milestone). When possible, it is best to study the entire population of students in your program. However, in larger programs it may be more pragmatic to study a sample of the students instead. If sampling, please describe the course sections and/or the milestones. If you have questions about appropriate sampling, please contact your unit's assessment representative or the Office of Assessment at assess@unm.edu or (505) 277-4130.

Please use the area below to elaborate on your assessment plans.

Assessing and analyzing student learning outcomes:

a. Please describe the student artifact/performance that you will use to gather your assessment data?

Two performances will be used to assess SLO 1. The first is the preparation of a research proposal as part of the comprehensive exam and the second is successfully completing our Departmental Seminar series.

b. Does your program assess all SLOs every year, or are they assessed on a staggered, three-year cycle? If staggered, please describe which SLOs will be assessed for each year. If a table better describes your response, insert it here.

A three-year cycle is used:
Year 1 - SLO 1
Year 2 - SLO 2
Year 3 - SLOs 3&4
We are in Year 1 of the cycle.

c. What is the process you will use to review, analyze and interpret your assessment data?

The preparation of two research proposals for the Ph.D. comprehensive exam and successful completion of our weekly departmental seminar will be the basis for the assessment. The comprehensive exam for Ph.D. students consists of two 15-page written thesis proposals in which students will outline their hypothesis, describe their plan for collecting and analyzing data, and describe potential outcomes. The written proposal is read by all committee members, and assessed for the student's ability to conduct the proposed research and objectively evaluate the results from their application of modern field, analytical, or computational methods. Thus, preparing this written research

d. What is the process you will use to communicate and implement your assessment results?

Collection of assessment data is conducted by the Graduate Committee Chair (Tobias Fischer). The compiled data are discussed by the graduate committee and then shared with the entire faculty to solicit feedback the assessment results and process.

Part III: Assessment REPORT Body
UNM Academic Programs/Unit Combined Assessment Plan and Report Template
The University of New Mexico

SECTION III-1

In response to last year's assessment report, please:

a. Describe the program changes that were implemented.

There were no changes to the program since last year.

b. Describe any revisions to your assessment process that were made for this reporting cycle.

There were no changes to the assessment process.

Please use the grid and narrative responses below to discuss your assessment results from this year:

SLOs (from PLAN above) *SLOs are from your entries in the PLAN above that were **measured during this year**:*	**Student Population** *Describe the sampled population, including the total number of students and classes assessed.*	**Results*** *State whether the performance benchmark was met, not met, or exceeded AND the total number of students assessed (i.e., Exceeded, 95 out of 111 (86%) students)* *For additional guidance on reporting results, click here.*
Students will summarize current research questions and approaches in one or more subfields in earth, atmospheric, and/or planetary science.	All students who have taken the weekly departmental seminar in the past 3 years.	The performance benchmark of at least 85% passing was exceeded. 21 students took the departmental seminar in the past 3 years and 100% passed.
PhD students will write at two research proposals that present a testable hypothesis, outline the types of data needed to test the hypothesis, and describe how the collected data will be used to test the hypothesis. They	All students who have taken Ph.D. comprehensive exam in the past 3 years.	The performance benchmark of at least 85% passing was exceeded. 10 students took the Ph.D. comprehensive exam in the past 3 years and 100% passed.
Students will read and critically evaluate primary scientific literature in one or more subfields in earth, atmospheric, and/or planetary science.	not assessed this year	
Students will devise and implement a field, experimental, analytical, and/or computational plan aimed at collecting and analyzing the data necessary to address a specific scientific question.	not assessed this year	
Students will present and defend the results of their research (orally or in poster format) in order to demonstrate mastery of the material and an ability to communicate the results and significance of their work to other scientists	not assessed this year	
Students will write a dissertation, or collection of manuscripts in which the motivation for the research is outlined, methods are described, data and interpretations are clearly separated,	not assessed this year	

SLOs (from PLAN above)	Student Population	Results*
Students will communicate the results of research carried out independently or as part of a team via publication of peer-reviewed articles, maps, meeting abstracts, and/or technical reports. Publication is an obligation inherent in the acceptance of funding for	not assessed this year	

NOTE: An asterisk (*) denotes that relevant data/evidence must be included for that column (refer to the "Annual Assessment Cycle Process" diagram for guidance). Evidence associated with program improvements/changes that are actually made or implemented have to be provided the next academic year/assessment period.

Please use the area below to elaborate on your findings.

Please identify the SLOs that did not meet your benchmark defined in the Assessment Plan. Elaborate on what you think contributed to this:

None, benchmarks were exceeded for all evaluated SLOs.

SECTION III-2

In response to <u>this assessment report</u>, please answer the following questions:

a. Who participated in the assessment process (the gathering of evidence, the analysis/interpretation, recommendations)?

The EPS Graduate Committee Chair, Tobias Fischer, led the process. EPS office staff helped gather evidence. The process and results were discussed with the Graduate Committee on December 9-11 2020.

b. Data Analysis: *Describe strengths and/or weaknesses of each SLO in students' learning/performance based on the data results you provided in the table above (e.g., Even though the benchmark was met, 40% of the students struggled with Topic X …).*

All students exceeded the performance benchmark for this SLO.

c. Based on your assessment results from this year and last year, describe the recommendations that you have for improvement:

- Describe any program changes (e.g., curriculum, instruction, etc.) that will be implemented.

No program changes are planned.

- Describe any revisions to your assessment process that will be made for the next reporting cycle.

No changes to the assessment process are planned.

d. How, when, and to whom will results and recommendations be communicated in a meaningful way?

The results were discussed by the graduate committee on December 9-11 2020 and communicated to the EPS Chair on December 11, 2020.

DEPARTMENT OF EARTH AND PLANETARY SCIENCES
EVALUATION OF PH.D. COMPREHENSIVE EXAMINATION – 3RD SEMESTER

STUDENT:
DEGREE: PH.D.
PROPOSAL SUPERVISOR #1: READER:
TITLE OF
PROPOSAL SUPERVISOR #2:
TITLE OF PROPOSAL #2

Please rate the following aspects of each component of the examination from 1= poor to 5= excellent

Component 1: Written proposal; 1= poor to 5= excellent

1A) The written proposals summarizes and critically evaluates current research questions and approaches in one or more subfields in earth, atmospheric, and/or planetary science ① ② ③ ④ ⑤

1B) Testable hypotheses are clearly delineated in the written proposal ① ② ③ ④ ⑤

1C) The proposals represents an appropriate test of the identified hypothesis ① ② ③ ④ ⑤

Comments on the written document:

Component 2: Oral presentation; 1= poor to 5= excellent

2A) The oral presentation clearly outlined a testable hypothesis and its significance for the field of study ① ② ③ ④ ⑤

2B) The oral presentation clearly differentiated data presentation from data interpretation ① ② ③ ④ ⑤

2C) The oral presentation was comprehensible to a broad earth sciences audience ① ② ③ ④ ⑤

2D) The student's oral presentation skills demonstrated proficiency in scientific communication ① ② ③ ④ ⑤

Comments on the oral presentations:

Component 3: Research defense; 1= poor to 5= excellent

3A) The student was able to defend the concepts, results, and importance of their research and how it fits into a broader area of inquiry ① ② ③ ④ ⑤

3B) The student's research is of high enough quality to be publishable in peer reviewed journals and/or presented at professional meetings ① ② ③ ④ ⑤

3C) The student demonstrated breadth and/or depth in understanding scientific concepts ① ② ③ ④ ⑤

Comments on the question and answer period

Component 4: Overall research; 1= poor to 5= excellent

4A) The scientific research presented shows competence in implementation of research methodologies ① ② ③ ④ ⑤

4B) The student showed scientific independence and creativity in the research, developing methods, and/or new interpretive techniques suitable for a **PhD** ① ② ③ ④ ⑤

4C) The student clearly delineated the significance of their research and its impact on broader areas of inquiry ① ② ③ ④ ⑤

4D) The scientific research presented is of appropriate scope and can be completed in the timeline of a **PhD** degree program ① ② ③ ④ ⑤

Comments on the scientific quality – overall impression

Appendix 4: [EPS DEI and Sexual Harassment Statements]

Earth and Planetary Sciences
221 Yale Blvd. NE
Northrop Hall 141
MSC03 2040
Albuquerque, NM 87131-0001

SEXUAL HARASSMENT CONCERNS

The EPS Department Chair and Faculty want to communicate a clear and consistent message that sexual harassment is unlawful and will not be tolerated in any classroom, laboratory, field, or off-campus conference situation. We are committed to providing a quality learning and working environment for all of our community that is free from any harassment or discrimination.

UNM defines sexual harassment as: *Sexual harassment, a form of sex discrimination, is defined as unwelcome conduct of a sexual nature. There are two typical types of sexual harassment: quid pro quo and hostile environment. Conduct of a sexual nature becomes a violation of this policy when: A) submission to such conduct is made either explicitly or implicitly a term or condition of an individual's employment or academic advancement (quid pro quo); B) submission to or rejection of such conduct by an individual is used as the basis for employment decisions or academic decisions affecting such individual (quid pro quo); or C) such conduct has the purpose or effect of unreasonably interfering with an individual's work or academic performance or creating an intimidating, hostile, or offensive working or academic environment (hostile environment). Go to:* https://policy.unm.edu/university-policies/2000/2740.html

Fieldwork is an important aspect of the Earth sciences where people are in closer social contact for longer time periods in potentially remote areas. We expect all fieldtrip leaders to provide a safe environment for each participant and help if something inappropriate does occur.

If you are affected by sexual harassment or you are simply uncomfortable or unsure about something that has happened, you have a range of options to follow depending on whether you want the situation to remain confidential or not.

YOUR OPTIONS

1) **Emergency situation** in urban setting

Call 911 if in any danger and call a trusted family member or friend.

2) **Non-confidential option**. All UNM employees (faculty, staff, TA) are 'mandatory reporters' and are required to report any incident discussed with them to the UNM Office of Equal Opportunity (OEO). If you choose this option, find a trusted UNM faculty, staff, or TA and discuss your situation. Information about sexual assault and/or misconduct will be treated confidentially and only be shared on a need-to-know basis, and as authorized under the UNM policy and applicable federal and state law. Mandatory reporters will communicate the information to OEO who will initiate a review to determine if UNM has

jurisdiction. The affected person can participate as little or as much as they prefer and can have advocacy at every step of the way. Details at: http://loborespect.unm.edu/faculty--staff/index.html

To make a complaint or report an incident, contact the Office of Equal Opportunity (OEO):

- **Hours***: Open Monday - Friday from 8am-5pm.*
- **Phone**: (505) 277-5251; email oeounm@unm.edu
- **Physical Location**: 609 Buena Vista NE, just west of (behind) Dane Smith Hall.

3) **Confidential options**. Contact any one of 3 UNM organizations listed below; these organizations are not required to report the situation and have a range of professional counselors and advocacy staff to help you. One can also report at SHAC for confidential counseling services; however, advocacy from SHAC is not available. Details at: http://loborespect.unm.edu/Get%20Help%20now/sexual-misconduct/sexual-assault-reporting.html

Contact information for these centers are provided below.

LoboRESPECT Advocacy Center

http://loborespect.unm.edu/advocacy-center/contact.html

- **Hours***: Open Monday-Friday 8am to 5 pm, 24 hour hotline*
- **Phone:** (505) 277-2911
- **Physical Location:** University Advisement & Enrichment Center, 2nd Floor, Room 262, next to Dean of Student Office

LGBTQ Resource Center

- **Hours*****: Open Monday - Friday 9 am to 5 pm***
- **Phone**: (505) 277-5428
- **Physical Location:** 608 Buena Vista (corner of Roma and Buena Vista), Bldg. 20A. The LGBTQ Resource Center is located in the lower level of Building 20A, on the corner of Roma Ave and Buena Vista Ave. This building is northwest of the Duck Pond, between Scholes Hall and Dane Smith Hall. Enter through the door in the courtyard facing Buena Vista Ave.

Women's Resource Center

- **Hours***: Open Monday - Wednesday & Friday from 8am-5pm. We have extended hours on Thursdays from 8am-7pm.*
- **Phone**: (505) 277-3716
- **Physical Location**: Mesa Vista Hall 1160, near Student Health Advocacy Center.

OTHER RESOURCES

UNM Student Health and Counselling (SHAC), Across the mall (east) from the SUB

Staff and Faculty can also receive counseling at CARS 272-6868, 1800 Mesa Vista Rd NE

Recent (2014) PLOS-1 article summarizing survey results of field experiences of sexual harassment and assault http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0102172

Hope Jahren's (geologist) excellent essay re: sexual harassment "She Wanted to Do Her Research. He Wanted to Talk 'Feelings.' http://www.nytimes.com/2016/03/06/opinion/sunday/she-wanted-to-do-her-research-he-wanted-to-talk-feelings.html

The Serial Harasser's Playbook or how to identify escalating harassment from a faculty member http://womeninastronomy.blogspot.com/2014/05/fed-up-with-sexual-harassment-serial.html

EPS Statement on Diversity, Equity and Inclusion

We, the community of Earth and Planetary Sciences at UNM, firmly believe that Black Lives Matter. We denounce the long history and recent acts of brutality on Black people and the oppression of their constitutional rights. We stand with Black and other people of color against systematic and institutionalized racism in academic culture. We recognize our responsibility to contribute to positive change in these systems. With this statement, we hope to demonstrate and reaffirm our commitment to anti-racism and inclusion, and to begin new and continue existing conversations with our community.

Our department is committed to working toward a culture of anti-racism and are planning to take the following steps:

1) Formalize a committee of EPS faculty, research staff, postdoctoral researchers, and students to support Diversity, Equity, and Inclusion. The mission of this committee will be to evaluate and recommend change to structures within our department policies, culture, and educational programs that perpetuate racial injustice.

2) Work with UNM's Division for Equity and Inclusion to develop inclusive, anti-racist guidelines for the EPS Department.

3) Seek out department-wide trainings to cultivate an anti-racist and inclusive departmental culture.

4) Re-evaluate graduate student admission processes to remove barriers to success that derive from systemic inequities.

5) Re-evaluate our department hiring and mentoring processes to remove barriers to success that derive from systemic inequities.

6) Amplify voices of and research performed by Black, Indigenous and other people of color. For example, by highlighting research by under-represented groups in our academic lectures and increasing colloquium invitations to under-represented scholars.

7) Hold ourselves and our community accountable for anti-Black and racist actions and dialogue.

Appendix 5: [Listing of Recent Graduate Students and Placements]

EPS GRADUATE STUDENTS MS & PHD

SEMESTER/YEAR	NAMES	Position After Graduation
PHD 2016		
Fall 2015	M. Magdalena Sandoval Donahue	NMT, NM Bureau of Geology & Mineal Resources / Wonder Women Tech
Spring 2016	Rebecca Frus	USGS, Nevada Water Science Center
Spring 2016	Rebekah Levine	Asst Professor, Univ of Montana Western
Spring 2016	Kathleen Vander Kaaden	NASA Project Manager, ARES Division
MS 2016		
Fall 2015	Hannah Gatz- Miller	PhD Program at the University of British Columbia - Vancouver
Spring 2016	Charles Hoots	
Spring 2016	Ryan Jackson	Went on to PHD program
Fall 2015	Christopher McGibbon	Went on to PHD program
Summer 2015	Alexandra Pickel	APS educator, Albuquerque
Summer 2015	Alec Tunner	Naval Research Laboratory
Spring 2016	Jeffrey Williams	
PHD 2017		
Summer 2016	Kevin Hobbs	NMT; NM Bureau of Geology & Mineral Resources, Field Geologist
Spring 2017	Hyunwoo Lee	Assistant Professor Seoul National University
Fall 2016	Alison Santos	NASA
Spring 2017	Lauren Wheeler	Sandia National Labs
MS 2017		
Fall 2016	Christine Allen	
Fall 2016	Rickey Bartlett	Went on to PhD Program Tulane University
Summer 2016	Valerie Blomgren	Environmental Consultant, Tulsa OK
Summer 2016	Jordan Gibbons	Went on to PHD program UNM
Spring 2017	Margaret Glasgow	Went on to PHD program UNM

Spring 2017	Thomas Luckie	
Spring 2017	Oleg Maltsev	
Fall 2016	Jennifer Muus	NM Environment Department - GeoScientist
Summer 2016	Rachel Price	
Fall 2016	Marisa Repasch	Went on to PHD program in Germany
Summer 2016	Jared Smith	Environmental Consulting, Albuquerque NM
Spring 2017	Zoltan Vaci	Went on to PHD program UNM
PHD 2018		
Spring 2018	David Decker	Southwest Geophysical Consulting, Owner
Spring 2018	Mark Holland	Asst Professor, West Texas A&M University
Spring 2018	Brad Jeffrey	
Spring 2018	Jonathan Lewis	NASA Postdoctoral Fellow
Spring 2018	Sheryl Singerling	US Naval Research Laboratory
MS 2018		
Summer 2017	Shaleene Chavarria	USGS, Hydrologist NM Water Science Center
Fall 2017	Anthony Gargano	Went on to PHD program UNM
Spring 2018	Tori Finlay	Environmental Consulting, Colorado
Spring 2018	Justin Peinado	El Paso, TX
Spring 2018	Nicole Thomas	USGS
Spring 2018	Cory Walk	Geologist/Natural Resource Specialist · Permits West, Inc
Fall 2017	David White	Senior Geologist, GEOLEX (Albuquerque)
Spring 2018	Han Zhang	Went on to PHD program UNM
PHD 2019		
Spring 2019	Carmen Winn	Sandia National Labs, Post Doctoral
MS 2019		
Summer 2019	Nels Bjarke	Went on to PHD program at UC Boulder
Fall 2018	Erick Cano	Went on to PHD program UNM
Summer 2018	Agathe Carrier	
Summer 2019	Keyi Cheng	Went on to PHD program at Michigan State University

Summer 2019	Jacquelyn Delp	
Summe 2019	Jon Golla	Went on to PHD program in Illinois
Fall 2018	Mya Habermann	Environmental Consulting, Alaska
Spring 2019	John Hamilton	Went on to PHD program UNM
Fall 2018	Rose Harris	Los Alamos National Labs
Fall 2018	Benjamin Holt	Outdoor educator, Albuquerque NM
Spring 2019	Jessica Johnson	Went on to PHD program UNM
Fall 2018	Damian Milazzo	Los Alamos National Labs
Spring 2019	Zhiyuan Ren	Researcher, China
Spring 2019	Jason Silviria	
Fall 2018	Spencer Staley	Went on to PHD program UNM
Summer 2019	Nolan Townsend	Assistant Engineer, Austin TX
Fall 2019	Justin Wilgus	Went on to PHD program UNM
Spring 2019	Pavel Vakhlamov	

PHD 2020

Summer 2020	Kristen Rahilly	Lecturer Columbia University
Summer 2020	Jacob Thacker	NMT; NM Bureau of Geology & Mineral Resources, Field Geologist

Appendix 6: [Faculty Credentials Template]

Appendix 6: Faculty Credentials Template
(FOR USE IN CRITERION 5)

Directions: Please complete the following table by: **1**) listing the full name of each faculty member associated with the designated department/academic program(s); **2)** identifying the faculty appointment of each faculty member, including affiliated faculty (i.e., LT, TTI, TTAP, AD, etc.); **3**) listing the name of the institution(s) and degree(s) earned by each faculty member; **4)** designating the program level(s) at which each faculty member teaches one or more course (i.e., "X"); and **5)** indicating the credential(s) earned by each faculty member that qualifies him/her to teach courses at one or more program levels (i.e., TDD, TDDR, TBO or Other). Please include this template as an appendix in your self-study for Criterion 5A.

Please add rows as necessary

Name of Department/Academic Program(s): Department of Earth and Planetary Sciences

Full First and Last Name	**Faculty Appointment** Continuing • Lecturer (LT) • Probationary/Tenure Track - Instructor (TTI) or Asst. Prof. (TTAP) • Tenured - Assoc. Prof. (TAP), Prof. (TP), or Dist. Prof. (TDP) • Prof. of Practice (PP) Temporary • Adjunct (AD) • Term Teacher (TMT) • Visitor (VR) • Research Faculty (RF)	**Institution(s) Attended, Degrees Earned, and/or active Certificate(s)/Licensure(s)** (e.g., University of New Mexico—BS in Biology; University of Joe Dane—MS in Anthropology; John Doe University—PhD in Psychology; CPA License—2016-2018) **Only Terminal Degree is Necessary**	**Program Level(s)** (Please leave blank or provide "N/A" for each level(s) the faculty does not teach at least one course.)		**Faculty Credentials** • Faculty completed a terminal degree in the discipline/field (TDD); • Faculty completed a terminal degree in the discipline/field and have a record of research/scholarship in the discipline/field (TDDR); • Faculty completed a terminal degree outside the discipline/field but earned 18+ graduate credit hours in the discipline/field (TDO); OR • Other (Explain)
1. Carl Agee	TP	Columbia University – PhD in Geological Sciences	Undergraduate	X	TDDR
			Graduate	X	TDDR
			Doctoral	X	TDDR
2. Yemane Asmerom	TDP	University of Arizona - PhD in Geochemistry	Undergraduate	X	TDDR
			Graduate	X	TDDR
			Doctoral	X	TDDR
3. Adrian Brearley	TDP	University of Manchester – PhD in Geology	Undergraduate	X	TDDR
			Graduate	X	TDDR
			Doctoral	X	TDDR
4. Laura Crossey	TP	University of Wyoming – PhD in Geology	Undergraduate	X	TDDR
			Graduate	X	TDDR
			Doctoral	X	TDDR
5. Peter Fawcett	TP	Pennsylvania State University – PhD in Geosciences	Undergraduate	X	TDDR
			Graduate	X	TDDR
			Doctoral	X	TDDR
6. Tobias Fischer	TP	Arizona State University – PhD in Geology	Undergraduate	X	TDDR
			Graduate	X	TDDR
			Doctoral	X	TDDR

Full First and Last Name	**Faculty Appointment** Continuing • Lecturer (LT) • Probationary/Tenure Track - Instructor (TTI) or Asst. Prof. (TTAP) • Tenured - Assoc. Prof. (TAP), Prof. (TP), or Dist. Prof. (TDP) • Prof. of Practice (PP) Temporary • Adjunct (AD) • Term Teacher (TMT) • Visitor (VR) • Research Faculty (RF)	**Institution(s) Attended, Degrees Earned, and/or active Certificate(s)/Licensure(s)** (e.g., University of New Mexico—BS in Biology; University of Joe Dane—MS in Anthropology; John Doe University—PhD in Psychology; CPA License—2016-2018) **Only Terminal Degree is Necessary**	**Program Level(s)** (Please leave blank or provide "N/A" for each level(s) the faculty does not teach at least one course.)		**Faculty Credentials** • Faculty completed a terminal degree in the discipline/field (TDD); • Faculty completed a terminal degree in the discipline/field and have a record of research/scholarship in the discipline/field (TDDR); • Faculty completed a terminal degree outside the discipline/field but earned 18+ graduate credit hours in the discipline/field (TDO); OR • Other (Explain)
7. Joseph Galewsky	TP	University of California Santa Cruz – PhD in Geophysics	Undergraduate	X	TDDR
			Graduate	X	TDDR
			Doctoral	X	TDDR
8. Karl Karlstrom	TDP	University of Wyoming – PhD in Geology	Undergraduate	X	TDDR
			Graduate	X	TDDR
			Doctoral	X	TDDR
9. Eric Lindsey	TTAP	University of California San Diego – PhD in Earth Sciences	Undergraduate	X	TDDR
			Graduate	X	TDDR
			Doctoral	X	TDDR
10. Tyler Mackey	TTAP	University of California Davis – PhD in Earth and Planetary Sciences	Undergraduate	X	TDDR
			Graduate	X	TDDR
			Doctoral	X	TDDR
11. Corinne Myers	TTAP	University of Kansas – PhD in Paleobiology	Undergraduate	X	TDDR
			Graduate	X	TDDR
			Doctoral	X	TDDR
12. Aurora Pun	LT (Principal)	University of New Mexico – PhD in Geology	Undergraduate	X	TDDR
			Graduate		
			Doctoral		
13. Brandon Schmandt	TAP	University of Oregon – PhD in Geological Sciences	Undergraduate	X	TDDR
			Graduate	X	TDDR
			Doctoral	X	TDDR
14. Louis Scuderi	TP	University of California Los Angeles – PhD in Geography	Undergraduate	X	TDDR
			Graduate	X	TDDR
			Doctoral	X	TDDR
15. Zachary Sharp	TDP	University of Michigan – PhD in Geology	Undergraduate	X	TDDR
			Graduate	X	TDDR
			Doctoral	X	TDDR
16. Gary Weissmann	TP	University of California Davis – PhD in Hydrologic Science	Undergraduate	X	TDDR
			Graduate	X	TDDR
			Doctoral	X	TDDR
17. Lindsay Worthington	TAP	University of Texas Austin – PhD in Marine Geology and Geophysics	Undergraduate	X	TDDR
			Graduate	X	TDDR
			Doctoral	X	TDDR

Full First and Last Name	**Faculty Appointment** Continuing • Lecturer (LT) • Probationary/Tenure Track - Instructor (TTI) or Asst. Prof. (TTAP) • Tenured - Assoc. Prof. (TAP), Prof. (TP), or Dist. Prof. (TDP) • Prof. of Practice (PP) Temporary • Adjunct (AD) • Term Teacher (TMT) • Visitor (VR) • Research Faculty (RF)	**Institution(s) Attended, Degrees Earned, and/or active Certificate(s)/Licensure(s)** (e.g., University of New Mexico—BS in Biology; University of Joe Dane—MS in Anthropology; John Doe University—PhD in Psychology; CPA License—2016-2018) **Only Terminal Degree is Necessary**	**Program Level(s)** (Please leave blank or provide "N/A" for each level(s) the faculty does not teach at least one course.)		**Faculty Credentials** • Faculty completed a terminal degree in the discipline/field (TDD); • Faculty completed a terminal degree in the discipline/field and have a record of research/scholarship in the discipline/field (TDDR); • Faculty completed a terminal degree outside the discipline/field but earned 18+ graduate credit hours in the discipline/field (TDO); OR • Other (Explain)
18. Jin Zhang	TTAP	University of Illinois Urbana-Champaign – PhD in Mineral Physics	Undergraduate	X	TDDR
			Graduate	X	TDDR
			Doctoral	X	TDDR
19.			Undergraduate		
			Graduate		
			Doctoral		
20.			Undergraduate		
			Graduate		
			Doctoral		
21.			Undergraduate		
			Graduate		
			Doctoral		
22.			Undergraduate		
			Graduate		
			Doctoral		
23.			Undergraduate		
			Graduate		
			Doctoral		
24.			Undergraduate		
			Graduate		
			Doctoral		
25.			Undergraduate		
			Graduate		
			Doctoral		
26.			Undergraduate		
			Graduate		
			Doctoral		

Appendix 7: [Faculty CVs] -

Please see additional documentation & materials

Appendix 8: [Peer Comparison Template]

Appendix 8: Peer Comparison Template
(FOR USE IN CRITERION 7)

With the understanding that not all programs are included in every peer institution, the APR Office recommends selecting **3 peer institutions** to use as comparisons.

	Total University Enrollment	Unit Undergraduate Degrees/Certificates Offered	Unit Undergraduate Student Enrollment	Unit Graduate Degrees/Certificates Offered	Unit Graduate Student Enrollment	Total # of Unit Faculty	Status/Ranks/ Comparisons (i.e., program goals, curriculum, faculty, and students, etc.)	Other (please specify)
PEER INSTITUTIONS	54,058	• BA • 3 Certificates	• 4-BA • 89-Certificate	• MA • 2 MS dual degrees • PhD	• 18-MA • 10-MS dual degrees • 7-PhD	215		
University of New Mexico	**27,300**	B.S. E&PS B.S. ENVS B.A. E&PS		MS PhD	15 MS 30 PhD	18	#46 US News & World Report Grad	
Arizona State University	72,000	B.S.		MS PhD			#15 US News and World Report Grad	
University of Arizona	44,800	B.S. Geology	220 – B.S.	M.S. PhD	26 MS 40 PhD	34	#8 US News and World Report Grad	
University of Wyoming	12,600	B.S. Geology B.S. Environ Geology and Geohydrology B.A. Geology and Earth Science	150 B.S. Geol 120 B.S. Env Geol 10 B.A. Geol Earth	MS PhD	40 MS 24 PhD	22	#46 US News and World Report Grad	