

Strategic Plan 2020-2025

Executive Summary

The Department of Geosciences is internationally recognized for its world-class research and effective and innovative approaches to Earth Science education. Over the next five years (2020-2025), the Department, capitalizing on emerging opportunities and challenges, will build on its past successes to lead the geosciences in new directions. The transition to clean energy and a post-carbon world will require forward-looking modifications to geoscience education and research programs. An increasing need to analyze large datasets will require geoscience students to obtain higher-level data skills for competing in the workforce. Addressing the lack of representation in the geosciences will require focused efforts to improve diversity at all levels, and to create more welcoming and inclusive work environments.

To meet these opportunities and challenges, provide community leadership, and ensure the Department's continued success, we will:

- **Elevate excellence and innovation in research** through maintaining core research strengths, building new strategic research thrusts, supporting creativity and innovation, improving links with industry and government agencies, and strengthening partnerships across the University
- **Equip students with skills to lead in a rapidly evolving academic and employment landscape** through improving the transferable skills the students develop, fostering awareness of sustainability and the environmental and social consequences of geoscience-related economic activities, developing new online courses, supporting student engagement within and beyond the curriculum, updating the graduate curriculum, and promoting field work preparedness for all students
- **Promote diversity, equity, and inclusion, a supportive and welcoming environment, and outreach** through building diverse and inclusive undergraduate and graduate programs, improving faculty and staff diversity, supporting community service and outreach efforts, and strengthening student and faculty mentoring

Introduction

The Department of Geosciences has long enjoyed a reputation as one of the top Earth Science research and education programs in the United States, a reputation reflected in a number of rankings. The 2018 US News and World Report of Earth Sciences graduate programs ranked Penn State graduate programs #1 in geology, #2 in environmental sciences, #2 in geochemistry, #6 in Earth Sciences, and #8 in paleontology. As we plan for, and look forward to building on the past achievements and successes of the Department between 2020 and 2025, we are motivated by a number of opportunities and challenges, some internally derived, and others reflecting a changing national educational and research landscape.

The core of a successful department is its faculty, and without maintaining a faculty of diverse top-notch educators and researchers, envisioning a successful future is not easy. Many of our faculty members hired in the 1980s and 1990s are approaching the end of their academic careers and will retire within the next decade. The anticipated turnover in faculty provides exciting opportunities for the Department to diversify and develop new strengths, as well as build on current areas of expertise.

A significant strategic planning challenge is envisioning what top-tier research and educational programs in the geosciences will look like in a post-carbon world. We recognize the world will be dependent on fossil fuels for many years to come, and the Department needs to maintain its strengths in core areas important for training students who want to pursue careers with petroleum exploration and service companies. It is also clear that a shift to clean energy is underway. The turnover in faculty in the next decade, during this time of energy transition, presents unique opportunities for the Department to lead the nation in new directions through geoscience education and research.

The shift to clean energy is taking place at the same time that our approach to doing science is rapidly evolving from access to ever-larger datasets. In turn, the availability of “big data”, combined with the need to process, model and interpret those data, is changing the skills geoscience students need for future careers. Successful geoscience research and education programs in a post-carbon, big-data world will no doubt continue to include many core geoscience disciplines, but they will also need to provide students with expertise in ancillary fields and help them develop higher-level data skills.

The geosciences remain the most underrepresented of all STEM fields, and to address this challenge we must continue to prioritize resources and efforts to diversify our faculty, staff and students, and strive to create a more inclusive and welcoming department. While the number of female faculty and students in the Department has risen considerably over the past few decades, faculty, staff and students of color still make up less than 10% of the Department.

With these opportunities and challenges before us, in this five-year strategic plan (2020-2025) we lay out our vision, articulated through achievable goals and objectives, for the Department’s continued success. The goals and objectives are tied together and strengthened by opportunities for enhancing diversity, improving our work environment, building greater community, and fostering outreach to diverse stakeholders.

Goal 1: Promote excellence and innovation in research to ensure a sustainable future

As faculty retire over the next decade, maintaining core strengths in the geosciences is essential to educate the leaders in Earth Science and for the Department to maintain excellence in critical geoscience disciplines. Balancing the needs of diversifying the faculty, supporting core research strengths, and developing new research thrusts through new faculty hires is best managed through a long-range planning process that extends beyond 2025.

Society is increasingly vulnerable to loss of life and property by geological processes (e.g., earthquakes, volcanoes, landslides), the effects of climate change (e.g., sea level rise, habitat shifts and losses, species extinction), and pollution. The Department should develop a new research thrust in GeoEnvironmental Risks (GeoRisks) and become a leader in this area by leveraging our considerable strengths in related fields (e.g., seismology, volcanology, rock mechanics, climate science). GeoRisks are highly relevant to society, have strong potential for growth in job opportunities, and also for developing new funding sources. Faculty hires in areas that focus on geoenvironmental science and policy, hydrology, risk analysis, sustainability, and urban geology would build on our current strengths and enhance educational opportunities for our students. GeoRisks also provides a strategic framework for maintaining and enhancing existing research strengths, for example in geohazards, climate change and its environmental effects, hydrogeology, and environmental pollution.

The Department should also develop new research thrusts in areas that require engagement with a critical mass of researchers extending beyond the geosciences. Examples include Clean Energy, Computational and Data Sciences, Critical Minerals, and Planetary Science. The Department should take a lead in building College and University strengths in areas relevant to the geosciences, and be positioned to leverage synergistic activities as they emerge at the College or University level.

A successful research enterprise requires a committed, engaged and productive staff, state-of-the-art facilities and infrastructure, a work environment conducive to productivity and collaboration, and strong links and partnerships with industry, government and across the University. Motivated by the importance of organic scientific discussion in maintaining and enhancing the Department's research excellence, opportunities for advancing such an environment must also be promoted.

Achieving this goal requires resources that could be limited in the next few years. We plan to invest wisely, by sharing lab spaces and equipment for new faculty, wherever possible, by leveraging positions through co-hiring with other units, wherever appropriate, and by seeking out new funding opportunities from foundations, government agencies and individual donors.

Objective 1: Maintain core research strengths and build new strategic research areas

Action Items:

- Prioritize hiring in the department-approved areas in Earth System History, Energy and Geomechanics
- Establish endowed positions for rewarding excellence and addressing faculty retention
- Create a planning committee to develop a 7-to-10 year hiring plan for multiple faculty positions spanning the later years of this plan (2022-2025) and continuing into the next five-year plan (2025-2030). The plan should consider possible retirements in the coming years along with the evolving research and educational landscape. The plan should have a

shorter-term focus, with recommendations on faculty hiring if retirements occur before 2025, and a longer-term focus, with recommendations for faculty hiring after that. New research areas the committee should consider are described in Objectives 2 and 3.

Objective 2: Become a leader in GeoEnvironmental Risks: Science and Policy

Action Items:

- Hire multiple faculty that build expertise in GeoRisks while enhancing existing strengths
- Host colloquia speakers to help identify emerging areas in GeoRisks
- Offer seminar courses in GeoRisks to build knowledge in the research community

Objective 3: Lead in critical College- or University-wide research efforts

Action Items:

- Hire one or more faculty in Critical Minerals and Planetary Science
- Strengthen engagement with the Institute for Computational and Data Sciences through new faculty hires that use large data sets and high-performance computing
- Invite colloquia speakers to help identify emerging areas in these critical areas
- Offer seminar courses in these critical areas to build knowledge

Objective 4: Maintain and enhance excellence by enabling the Department's research enterprise, fostering creativity and innovation, improving links with industry and government agencies, and strengthening partnerships across the University

Action Items:

- Complete lab renovations for new faculty and continue promoting use of shared spaces wherever practical
- Develop a plan for long-term technical staff support
- Develop an industry and government engagement plan that includes opportunities for partnerships
- Support and promote faculty creativity with seed grants
- Develop a fund to support student research activities (e.g., travel, team-building, summer stipends, undergraduate research)
- Increase competitiveness of graduate student recruiting by providing research funds for incoming students, and develop a strategy for growing the support in the future
- Establish a committee to develop and maintain a portfolio of research needs the development office can use for fundraising
- Strengthen partnerships and leverage opportunities across the University, for example by working with the Water Council to build the University-wide Water initiative.

Timeline for Major Objectives, Goal 1

Academic Years 2020-2022

- Hire in Earth System History, Energy, and Geomechanics
- Establish Planning Committee
- Completion of lab renovations
- Provide seed grants for faculty
- Establish committee to develop and maintain a portfolio of research needs
- Invite colloquia speakers and offer seminar courses in GeoRisks and emerging areas

Near Term (2021-2023)

- Provide research grants for incoming graduate students and develop a plan to grow funding
- Develop hiring plan for 2023 and beyond

Longer Term (2021-2025)

- Develop long-term plan for technical staff support
- Support student research enterprise via development efforts
- Establish endowed positions for rewarding excellence and addressing faculty retention
- If retirements occur, hire diverse faculty in areas prioritized by planning committee, including in GeoRisks, Critical Minerals, Planetary Science, and core disciplinary fields.

Goal 2: Equip students with skills to lead in a rapidly evolving academic and employment landscape

Looking to a future in which demands for resources such as clean water, fertile soil, and renewable energy increase at the same time that oil and gas jobs may decline, students will need an expanded skill set to be at the forefront of the employment market. A strong foundation in classical geology coupled with training and exposure across the breadth of geoscience subdisciplines has long been the hallmark of the Department's educational program. The need for diverse, scientifically literate and intellectually flexible problem-solvers is certain to grow as society faces the reality of climate change, energy transition, environmental degradation, resource scarcity and population growth in coming years. Over the next five years, we will strive to maintain the strengths of our curriculum while working to diversify our student body and improve the transferable skills our students develop.

Objective 1: Expand the transferable skills of our students, including data analytics, technical writing, and oral communication

Action Items:

- Develop a new quantitative data-focused geosciences course to possibly replace the "3 credits of computer science, advanced math, or statistics" requirement in the Geosciences BS degree or to be offered as an elective course
- Incorporate communication and writing skills into the Earth Science and Policy BS via EARTH 400 (Earth Science Seminar) and EARTH 495 (Internship)

- Expand skill sets built and assessed through field work, including field camp and other field-based activities

Objective 2: Foster awareness among students of sustainability, and the environmental and social consequences of geoscience-related economic activities

Action Items:

- Promote opportunities to address sustainability and the environmental and social consequences of geoscience-related economic activities in core curriculum (GEOSC 001, 201, 202, 203, 204, 310, 472)
- Create a new 400-level elective course on Environmental and Climate Impacts of Human Activities and require it for the Hydrogeology “professional” track
- Promote engaged scholarship opportunities with a sustainability or climate focus such as CAUSE and City Semester Pittsburgh
- Continue to develop and promote the Earth Science and Policy major, the Earth and Sustainability minor and the Earth Sustainability Certificate
- Develop Advanced Environmental Earth Systems minor to replace outdated Earth Systems minor

Objective 3: Strategically develop online course offerings to meet demand and provide new opportunities for students

Action Items:

- Develop a large-enrollment online Gen Ed course such as GEOSC 40 (The Sea Around Us) to complement GEOSC 10
- Adapt Earth Sustainability classes for larger enrollment
- Develop online 300-level elective courses for University Park and Commonwealth Campus students
- Develop an online version of GEOSC 001 to be offered at Commonwealth Campuses via the Digital Learning Cooperative

Objective 4: Support diversity, inclusivity, and student engagement within and beyond the curriculum

Action Items:

- Increase student participation in City Semester Pittsburgh through financial aid, advertising, and alignment with degree requirements
- Develop opportunities for community engagement and exchange via Penn State Pittsburgh Center (CITY)
- Work with Commonwealth Campus advisors to facilitate Earth Science and Policy students enrolling in City Semester the summer before arriving at University Park as a bridge
- Resume the junior seminar to help acclimate change-of-campus students

Objective 5: Update graduate curriculum to best serve the evolving needs of students

Action Items:

- Build diversity and inclusivity discussion, reading, and training into the GEOSC 500 curriculum
- Update Quantification course offerings to include modern coding languages and techniques
- Revise and develop (as needed) Disciplinary Fundamentals classes that are representative of current faculty expertise and graduate student research areas

Objective 6: Promote field work preparedness for all students

Action Items:

- Provide need-based scholarship/award opportunities for Field Camp
- Make good-quality loaner gear available for sign-out
- Provide access to First Aid/Wilderness First Aid training

Objective 7: Track graduates to develop a better understanding of career trajectories

Action Items:

- Work with University career office to track post-graduation job placement
- Grow Penn State Geosciences Alumni LinkedIn group

Timeline for Major Objectives, Goal 2

Academic Years 2020-2022

- Incorporate communication and writing skills into Earth Science and Policy curriculum
- Identify and promote opportunities to address sustainability and the environmental and social consequences of geoscience-related economic activities in core curriculum
- Promote engaged scholarship opportunities such as CAUSE, City Semester Pittsburgh
- Increase student participation in City Semester Pittsburgh
- Resume junior seminar to help acclimate change-of-campus students
- Provide need-based scholarship/award opportunities for Field Camp

Near Term (2021-2023)

- Develop a new undergraduate quantitative data-focused geosciences course
- Create a new 400-level elective course on Environmental and Climate Impacts of Human Activities
- Develop online 300-level elective courses for University Park and Commonwealth Campus students
- Build diversity and inclusivity discussion, reading, and training into GEOSC 500 curriculum
- Make good-quality loaner field gear available for sign-out
- Provide access to First Aid/Wilderness First Aid training for students and teaching assistants
- Grow Penn State Geosciences Alumni LinkedIn group

Longer Term (2021-2025)

- Expand skill set built and assessed through field work
- Develop a large-enrollment online Gen Ed course such as GEOSC 40
- Adapt Earth Sustainability classes for larger enrollment
- Develop an online version of GEOSC 001
- Update Quantification course offerings to include modern coding languages and techniques
- Revise and develop (as needed) Disciplinary Fundamentals classes
- Work with University career office to track post-graduation job placement

Goal 3: Promote diversity, equity, and inclusion, foster a supportive and welcoming environment and expand outreach

We strive to promote all aspects of diversity in STEM fields by taking the approach that creating and supporting an equitable and inclusive environment is important across all levels. We seek to produce the next generation of diverse geoscientists through enhancing and developing innovative programs and opportunities, and identifying and eliminating policies that may limit participation based on race or gender. We recognized that all faculty, staff, and students have a personal responsibility to engage in efforts to improve diversity, equity, and inclusion (DEI) in the Department. Growing a diverse faculty through targeted recruiting, as well as supporting existing faculty to lead new programs and work with students, is foundational to achieving this goal.

We also understand the need for a welcoming and supportive working environment. Efforts to build a diverse, collegial community in the Department require an inclusive environment, and an influx of new hires and the changing demographic of the graduate student population will bring a large number of scholars to the Department who will thrive in a supportive environment. Communication of our science through outreach is also critical for enhancing diversity, and also to develop an informed and scientifically literate citizenry.

In 2018-2019, the College of Earth and Mineral Sciences conducted an “Assessment of the Living, Learning, and Working Environment” (ALLWE; <https://www.ems.psu.edu/allwe>) and the results were distilled into an implementation plan for the College. To help fulfill this goal, the Department will implement relevant recommendations from the ALLWE survey.

Objective 1: Build diverse and inclusive undergraduate and graduate programs**Action Items:**

- Improve course material with a renewed emphasis on job focused skills-based projects, including data collection and synthesis
- Strengthen online presence in websites and other social media with images that 1) are up to date and inclusive of the diverse geoscience community, 2) feature non-field based research which may be more representative of the broader work we do, 3) highlight relevant skills development that is applicable to the job market, 4) improve use of Twitter feed
- Continue to support the Fort Valley State University 3+2 program
- Develop a bi-annual seminar around mentoring or exposing students to non-academic careers

- Leverage the Penn State Alumni network to recruit and retain students from colleges and universities with diverse and multicultural student bodies
- Become a participating institution in the AGU Bridge program
- Broaden social opportunities for undergraduates to informally interact with graduate students and faculty in low stakes settings, like colloquium or coffee/donuts, and make graduate students and faculty more visible to clubs/organizations that promote diversity in STEM
- Establish written policies for graduate student application reviews by the Admission Committee to ensure holistic evaluation of applications from person to person and year to year

Objective 2: Improve faculty and staff diversity

Action Items:

- Develop targeted recruitment strategies, write job ads broadly and include strong language about our DEI values
- Instruct search committee on best practices for application review and interviewing to reduce implicit bias
- Elevate diversity awareness and support diversity efforts by appointing a Director or Associate Head for Diversity Programs
- Modify promotion and tenure criteria to explicitly include work on diversity, equity, and inclusion
- Track and reward service and DEI initiative participation, particularly for early career faculty, to ensure equal contribution of faculty from all backgrounds, particularly regarding DEI initiatives which are customarily delegated to female or minority faculty

Objective 3: Promote an inclusive academic environment across levels

Action Items:

- Form a Diversity, Equity, and Inclusion Committee to provide advice on diversity initiatives, support the Director of Diversity Programs, and interact with student groups
- Include in building renovations plans spaces needed for a changing workplace
- Develop financial support for childcare and meeting travel to facilitate participation of faculty with young families
- Develop speaker series on diversity issues to bring awareness to important issues and strategies for increasing representation
- Revise departmental ombudsperson model for conflict mediation, reporting processes, support structure for graduate students and faculty

Objective 4: Strengthen community service and outreach efforts

Action items:

- Start a new outreach lecture series for the local community, such as the Frontiers of Science lectures or neighborhood lectures at Carnegie Institution for Science
- Create a department TV monitor to highlight departmental functions and announcements

- Pool resources with PA Space Grant and EESI programs for expanding outreach and diversity initiatives
- Continue to support the Shake-Rattle-Rocks program

Objective 5: Strengthen student and faculty mentoring

Action items:

- Strengthen colloquium series and make it more inclusive
- Review, revise, and strengthen mentoring processes for faculty, grad students, and staff
- Develop an onboarding process for new faculty on key programs and practical details of working in the Department
- Create a peer to peer mentoring program (juniors and seniors mentoring freshmen and sophomores, or graduate students mentoring juniors and seniors), with special focus on change-of-campus students and expansion of programs like WISER/MURE/FURP to include upperclassman in funded research

Timeline for Major Objectives, Goal 3

Academic Years 2020-2022

- Hire Associate Head or Director of Diversity Programs
- Develop targeted recruitment strategies
- Improve online presence in websites and other social media
- Become a participating institution in the AGU Bridge program
- Continue to support the Fort Valley State University 3+2 program
- Form DEI committee
- Explore colloquium time change, review structure of colloquium committee
- Develop onboarding process for new faculty
- Modify promotion and tenure criteria to explicitly include work on diversity, equity, and inclusion.
- Create peer to peer mentoring program
- Continue to support the Shake-Rattle-Rocks program

Near Term (2021-2023)

- Incorporate thoughtful spaces into Deike building renovation plans
- Develop speaker series on diversity issues
- Revise departmental ombudsperson model
- Develop a bi-annual seminar around mentoring or exposing students to non-academic careers
- Create community outreach lecture series
- Pool resources for stronger outreach and diversity activities
- Review and revise Department mentoring processes for students, faculty, and staff