

Earth and Environmental Sciences at Lehigh

EES Ten-Year Strategic Plan (approved 11/30/2021)

Executive Summary. The Earth and Environmental Sciences are of fundamental importance to society. As world population grows, consumption and the demand for resources increases, as does our impact on the Earth and environment. Human activities are a driving force of environmental change, now and into the future. To survive and prosper as a global community, we must design and implement sustainable, equitable, approaches to resource use and development, cultivate an ethic of stewardship, and adapt to climate change. The impact of environmental change, unequal access to resources and ecosystem services, water quality and quantity, environmental justice, environmental health, and community resilience play out on local, national, and global scales. While the impacts differ for specific individuals, communities, and countries, they are intertwined in complex ways that reveal interdependencies and leave no one untouched. Awareness and understanding of Earth and environmental science is critical for future professionals and citizens to meet the challenges we face.

This document lays out a vision for the growth and development of the Department of Earth and Environmental Sciences (EES) to focus department efforts and guide decision making. Our strategic plan is organized around three themes that define our efforts over the next five to ten years:

- 1) Research in Earth and environmental sciences for discovery and in service to society.
- 2) A focus on student success in our non-major courses, and in our undergraduate and graduate programs.
- 3) Diversifying our department and the Earth and environmental sciences more broadly as fundamental to achieving excellence.

To make progress in these areas we outline the following strategies:

- Shift our approach to hiring so that it is mission-oriented, tied to outcomes, and flexible and agile: integrating a range of tenure track and non-tenure track faculty, early career scientists, and staff to grow our research portfolio, enhance our educational programs and student success, and contribute to greater diversity in our department.
- Adopt a more holistic approach to working with our undergraduate and graduate students: blending content, skills, and professional development with more intentional mentoring, recognizing and supporting the unique contributions and potential of each individual and equally valuing the full range of pathways and careers our students will pursue.
- Establish a ‘Pathways Initiative’ including: outreach to South Side schools and partnerships with one or more underrepresented minority colleges/universities to attract a more diverse population to the Earth and environmental sciences, engage more proactively with the diverse community of Lehigh students attracting them to study and major in EES, and use our AGU Bridge Partnership and the GEM program to build diversity in our graduate program.

EES Mission Statement: We study the Earth and environment, how the solid earth, oceans, atmosphere, and life interact to shape the world in which we live. Our research is incorporated into field-based, experiential, multidisciplinary education and integrates observational, experimental, theoretical, and numerical approaches. We seek to instill in our undergraduate and graduate students the critical thinking, quantitative, and communication skills needed to succeed in life. Engagement with diverse perspectives and people enhances our research and is integral to educating our students. We seek to enhance earth science literacy through academic and outreach activities so that individuals and communities can make informed decisions about land use, biodiversity, resources, hazards, and climate change.

EES Statement on Diversity and Inclusion: The EES department is committed to the personal and intellectual growth of our students, faculty, and staff by promoting a positive and inclusive environment. We strive to recruit, support and fully engage a diverse student body, staff and faculty, and to create and maintain a collegial and rich learning environment that values and promotes inclusiveness in all activities. We have joined with the entire University community in embracing *The Principles of Our Equitable Community* and we work with university and national efforts to support our diversity and inclusion mission.

Below we describe the importance of a strong department of Earth and environmental sciences to a modern university and our contributions to research, teaching, service, and University initiatives. These sections are followed by our goals and specific plans for research, education, and diversity and inclusion over the next five to ten years, and our integrated ten-year hiring plan.

EES at Lehigh - The Value Proposition. Together, faculty and staff in EES support and carry out research and teaching that promote the study of how life, water, the atmosphere, and the solid-Earth have evolved and shape the environment in which we live. Earth and environmental science is unique among the liberal arts and sciences in the time and spatial scales at which Earth systems operate, from nanoseconds to billions of years, and from subatomic to the whole Earth. It is also unique in its study of the co-evolution of life with the physical Earth systems that in modern times includes the interactions between human society and culture and the Earth and environment. To understand our planet, how Earth systems influence our lives and in turn how our lives impact Earth systems, requires systems integration across disciplines, a combination of technical and analytical skills, collaboration, expertise in communication and visualization, and an appreciation for and an ability to deal with complexity, uncertainty, and risk.

Research and education in Earth and environmental science capture the imagination and inspire exploration and discovery of our dynamic planet and our solar system. Understanding the complexity of interacting Earth systems is critical for economic development and the resources on which it depends: energy, minerals, water, and food. Insight into how our planet operates is essential for building resilient communities in the face of geohazards: earthquakes, volcanic eruptions, landslides, floods, tsunamis, wildfires, and climate change. Determining the impact of human activity on the Earth and environment is crucial for protecting ecosystem services: biodiversity, landscapes, clean air and water, nutrient cycling, soil productivity, and climate regulation that sustain life and human health and well-being. A strong Earth and environmental science department is essential to any university seeking to make a difference in the world.

The pursuit of science is a human endeavor. To get the best outcomes — to advance our field, to meet pressing societal challenges, and to educate and prepare our students for successful lives

and careers — requires that we attract the best people to the Earth and environmental Sciences. To do this, we must broaden participation from historically underrepresented groups and ensure that all members of our community are supported and included. To achieve excellence, we must tap into the creativity and innovation inherent in the diversity that makes up society at large. To succeed as a department we are prioritizing diversity and inclusion efforts across department operations, research, teaching, and service. This includes a department climate and culture that truly welcomes and supports difference. We are engaged in national efforts to enhance diversity in the geosciences supported by the National Science Foundation and by the major professional societies representing our fields: the American Geophysical Union, the Geological Society of America, and the Ecological Society of America. Efforts in EES can play a role in transformation at Lehigh, as the university's success requires embracing the excellence inherent in diversity.

Snapshot of EES Contributions to Research, Teaching, Service, and University Initiatives.

Much of the **research** in EES falls broadly into two thematic areas: the solid Earth and the environment. In detail, the breadth of research expertise in EES spans a diversity of subfields in astrobiology, climate science, cryology, ecology, geology, geochemistry, geomorphology, geophysics, hydrology, oceanography, paleoecology, remote sensing, tectonics, and volcanology. Most of our research is interdisciplinary, carried out individually or in collaboration with colleagues at Lehigh or elsewhere around the globe. We expect EES faculty to maintain vibrant externally funded research programs that support students and early career scientists, computational and analytical facilities, and research costs that for many involve field studies extending across the US and in other countries. Our study sites extend from the deep oceans to the high Himalaya, from our local community to six of the world's seven continents, from the arctic to the Antarctic, and to other planets. We operate and maintain state-of-the-art facilities in stable isotope geochemistry, noble gas geochronology, microbial ecology, aqueous and gas geochemistry, paleoecology, remote sensing and image processing, GIS, paleomagnetism, and seismology. Funding for our research comes from diverse sources including the NSF, NASA, NOAA, DOE, DOD/Army, U.S. Geological Survey, EPA, the Department of State, and national laboratories. Over half of our faculty are fellows and/or award recipients at professional societies in recognition of their leadership.

As a department, we integrate our research into **teaching** undergraduate and graduate students, preparing them for the workforce, and/or advanced study, and to be productive members of their community and society. We offer an undergraduate minor and B.A., B.S., M.S., and Ph.D. degrees in EES. Our curriculum is designed to balance core concepts and skills with flexibility for students to tailor their program to meet interests and career goals. Our students can pursue internships, research, field experiences, and study abroad opportunities as part of their degree program. Our courses blend classroom, laboratory, and field studies, incorporating quantitative analysis and modeling and emphasizing writing and communication skills. Our B.S. is a technical degree producing graduate school-competitive students that meet well-defined needs for a STEM-based workforce at the national level (**Figure 1**). Our B.A. reflects the core science of the Earth and environment, while providing flexibility to allow a student to pursue a minor or another major program in CAS or in the business, engineering, or health colleges. B.A. students are well-prepared to pursue a variety of careers building on their EES knowledge and skills (**Figure 1**). Both the M.S. and Ph.D. are considered terminal graduate degrees in EES. Our graduate students pursue careers in business, industry, government, and academics. We have well-defined learning outcomes for our undergraduate and graduate programs. Over a decade

ago, we made a major commitment to improving science literacy, making our science accessible to non-majors. We moved away from offering large survey-based introductory courses to providing a series of thematically based ‘gateway’ courses on a range of topics relevant to society. We view our contributions to science literacy as equal in priority to educating our undergraduate majors and graduate students.

High-quality **service** is essential to advancing our field and Lehigh. Over half of the EES faculty engage in significant, high-profile professional service: they have initiated and led major national and international initiatives, led major consortia, served in leadership roles in professional organizations, held editor and editorial board positions, and regularly served on funding agency review panels. These efforts help set new directions in our field and support infrastructure required for research. They also help build Lehigh’s reputation as a research university. At Lehigh, EES faculty routinely serve on college and university committees in both elected and appointed positions. Over the years, EES faculty have held leadership positions in administration, led interdisciplinary programs, chaired college and university committees, and served in the Faculty Senate and as university Ombuds.

Beyond EES, our breadth and interdisciplinary approach position us well to contribute to **university initiatives** and strengths in the environment, sustainability, data science, health, natural hazards, and global studies. EES faculty have actively participated in programs such as the Environmental Initiative, Health Medicine and Society, Sustainability, South Mountain College, Mountaintop, and Lehigh Launch.

Goals and Action Plans for Research, Education, and Diversity and Inclusion. In the following sections, we articulate our interrelated goals and action plans for research, education, and diversity and inclusion over the next ten years. To achieve our goals, we propose an integrated hiring plan incorporating tenure track and non-tenure track faculty, early career scientists, and staff. Supporting data for each subsection: research, education, and diversity and inclusion are provided in the **Supplementary Materials**.

Research

- **Goal:** increase EES research profile and portfolio.
- **Actions:** implement an integrated hiring plan for faculty and staff, strengthen the graduate program, and improve research infrastructure.

The generation of new knowledge and original contributions to our field is central to the mission of the department. Active research is essential to advancing our field and meeting critical societal needs. Active research programs raise our visibility and reputation, foster a lively and stimulating intellectual environment in the department, keep our curriculum current and dynamic, and make our students more competitive on the job market. Top tier research requires external funding to cover field, computational, and analytical costs, maintain facilities used in research and education, sustain a vibrant high-quality graduate program, and through indirect cost return help support basic department operations.

Research-active faculty maintain external funding through the regular submission of successful grant proposals. They successfully mentor graduate students and postdocs. They regularly disseminate research through peer reviewed publications, national/international conferences, and invited talks. Evidence of active research is also demonstrated through visible, impactful

professional service. A strong nationally/internationally recognized research program is necessary for tenure and promotion to Associate Professor. Sustaining that research program while increasing impact is necessary for promotion to Full Professor.

For EES to succeed, we need all faculty to maintain active research programs, attracting external funding and publishing research that advances our field. Maintaining an active research program is challenging given competing demands for time between research, teaching, and service, the ever-changing landscape for external funding, the management of research, and the time and technical expertise required to maintain increasingly complex research facilities. It is well recognized that competition for external funding is increasingly challenging as budgets at funding agencies have been flat for years in the majority of fields, while the number of individuals and groups seeking funding continues to grow. Research in EES tends to bear high costs for field work and analytical expenses. Nevertheless, a majority of EES faculty are research-active, through perseverance, hard work, and an entrepreneurial spirit. If for some reason a tenured faculty member no longer conducts impactful research or cannot maintain external funding at levels sufficient to fund graduate students and maintain research facilities, they can maximize contributions to meeting department goals through increased teaching and service.

While Lehigh considers itself a research university, the infrastructure for supporting research is mixed and uneven, from the level of support provided by the Office of Research and Sponsored Programs in proposal submission and grant administration, to the degree of technical support available for computational and analytical facilities. In EES, faculty spend far more time supporting research (as opposed to carrying out research) than our colleagues at peer institutions. Success in research at Lehigh requires improved infrastructure for research.

Specific actions to grow our research profile and portfolio:

- leverage faculty renewal to attract, engage, and retain excellent faculty scholars and staff through an integrated hiring plan: grow the number and percentage of research active faculty
- build a diverse faculty and staff to tap into the best individuals in our field and creatively engage students in research and scholarship
- continue to integrate research with instruction and mentoring of undergraduate and graduate students, serving society in preparing next generation scientists to enter their desired careers
- engage with others at Lehigh University in multidisciplinary research programs and initiatives on timely topics benefiting from our perspectives
- maintain a steady rate of submission of proposals to external grant agencies, ensuring ample funding success
- strengthen our graduate program including increasing R.A. support from external grants and growing the number of Ph.D. students
- manage faculty teaching responsibilities over a multiyear cycle to accommodate the need for focused time for research by providing flexibility in course rostering with the possibility of having some semesters with no teaching obligations beyond student research mentoring
- maintain a vibrant and diverse department seminar series and the Donnel Foster Hewett Symposia stimulating new ideas and collaborations and targeting opportunity hires

Undergraduate and Graduate Education

- **Goal:** increase our educational impact by focusing on student success in our undergraduate and graduate programs and improving science literacy at Lehigh; broaden participation in the Earth and environmental sciences from historically underrepresented groups.
- **Actions:** adopt a holistic approach to student outcomes blending content, skills, and professional development with greater mentoring; build an inclusive department climate and culture; help students prepare for the full range of pathways and careers available; provide better coherence across the undergraduate program, strengthen the graduate program, and implement integrated hiring plan for faculty and staff.

Given the importance of the Earth and environment to society and the critical juncture at which we sit, our primary goal over the next decade is to increase our educational impact by growing the numbers of students we impact and focusing on the success of the students with whom we engage. Our goal is to contribute to the education and training of a diverse range of professionals to meet the challenges we face with respect to climate change, land and resource use, water quality and quantity, community resilience, and ecosystem services. We will continue to educate and train scientists who reveal the physical, chemical, and biological inner workings of Earth, and by extension, other planets. We also seek to educate citizens who ultimately will make the decisions that shape our future. In the next decade, we aspire to build a truly diverse and inclusive community in a way that keeps barriers low and establishes a welcoming, supportive environment. Our educational contributions span three areas: undergraduate education of majors, undergraduate non-major education (minors and general education science literacy), and graduate education. We look to grow the number of students engaged in all three areas and to improve student outcomes in each area. Broadening participation and ensuring an inclusive culture are essential to improving student outcomes.

Specific Actions to improve both our undergraduate and graduate programs:

- increase diversity within our undergraduate and graduate student population
- foster an inclusive department climate and culture and build community
- adopt inclusive teaching practices
- raise awareness of intersectionality, implicit bias, bystander intervention and allyship
- develop an approachable, trustworthy, and accountable support network composed of peers, staff, and faculty
- enhance our long commitment in quality non-major education about pressing environmental issues
- promote and prepare students for diverse career opportunities, including potential modifications to curriculum, mentoring, and career coaching; tap into alumni and external networks more effectively
- build and sustain strong external professional networks and partnership with Lehigh career services.
- continue efforts to increase synergy among our courses
- spotlight the diversity of student accomplishments on the web, and in social media, and in the newsletter
- make better use of social media to engage with students
- establish annual student awards to recognize ‘Contributions to Community’ with nominations from students, faculty, and staff
- create avenues for student participation in an EES ‘Pathways Initiative’

Undergraduate Program. All indications are that the breadth and diversity of our undergraduate curriculum afford Lehigh students training that aids them in their career objectives. Roughly a third of EES graduates pursue post-baccalaureate training entering graduate programs in EES. A third enter the workforce pursuing EES careers in the education, energy, water resources, and consulting sectors. The remaining third pursue a range of other careers applying the skills and knowledge they learned in EES in information technology, law, communication, health sciences, business, sustainability, military service, and other pursuits. There is room for growth in both the number of majors and total grades awarded in EES.

The EES majors and minor offer students a unique blend of classroom learning, hands-on learning in labs, exposure to numeric techniques and modeling, emphasis on writing, discovery and learning by observing the Earth as an outdoor classroom, and access to funded undergraduate research projects. This balance of observation, discovery, learning, and research deserves continuing support in the coming decade. Both anecdotal and exit interview data indicate that the students greatly appreciate the flexibility our program affords as they essentially customize their program to suit their interests and career goals. We have a stable teaching rotation; the timing of when courses are being offered is generally well-known and advertised to students. As a result, students are able to plan to take advantage of other curricular and personal growth opportunities including study abroad, summer programs, and internships. Nevertheless, certain efficiencies can be realized, and new opportunities pursued. We have an opportunity to build stronger connections and common learning themes between our individual courses. In this way, students will realize and master a common, core body of knowledge, skills, and ways to problem solve aligned with our learning outcomes.

EES regularly contributes CAS first-year seminars and our EES gateway courses are thematic issues-oriented courses designed to meet distribution and general education requirements. The goal of these courses is to increase Earth and environmental science literacy to produce citizens who are informed and understand the value of fact-based decision making regarding the growing number of environmental challenges that need to be addressed now and in the decades to come. EES gateway courses are 3-credit lecture/discussion courses, many of which are designed to enroll ~20-30 students per course to provide for a high level of student engagement. There is high demand for these courses pushing recent enrollments to 40-70 or even higher numbers of students per course (a total of 912 students enrolled in these courses in AY 20-21; see the **Supplementary Materials**). Students can pair EES gateway courses with a 1-credit discussion course (EES 004) exploring the science behind environmental issues, or a 1-credit stand-alone laboratory course (EES 022) developing Earth and environmental science literacy, to meet natural science distribution requirements. The EES gateways, EES 004, and EES 022 are some of our highest impact contributions to the college and university and to society beyond. Even a quick look at the current events shows the critical need for improving science literacy in general and for the science behind important EES issues impacting society. Similarly, as CAS continues to discuss the future of distribution requirements, we note that the EES curriculum is well-positioned to offer the kind of in-depth, student inquiry driven general non-major education that may emerge in the next decade. We are already offering accessible courses that ask big questions and investigate contemporary challenges of sustainability and conflict and security.

Specific Actions to improve our undergraduate programs:

- increase visibility and impact of our undergraduate programs and courses on campus: make better links to potential careers, preparation for professional schools, and opportunities to pair with other majors; outreach to first-year students; symposia, seminar speakers, and blogs on trending topics and current events
- strengthen the B.S. degree by integrating skill sets and training into specific courses to help students achieve professional certification: professional geologist (PG), certified hydrologist (CHG), professional geophysicist (PGp), geologist in training (GIT), environmental scientist in training (E.I.T.) and Professional Ecologist (ESA).
- add additional issue-based gateway courses to meet student demand
- continue engagement with interdisciplinary programs: the Environmental Initiative, Health Medicine and Society, Sustainability, Mountaintop, Environmental Health, and Lehigh Launch
- translate pedagogical innovation forced through switch to online learning to post-COVID courses and curriculum
- incorporate urban environments into our curriculum, up to including a new course exploring Earth and environmental science issues in urban environments; use the South Side, Lehigh Valley, and broader regional area as exemplars extensible to other urban environments; link this to our ‘Pathways initiative

Graduate Program. Both the M.S. and Ph.D. in EES are research-based degrees. Stipends and tuition are provided by varying combinations of R.A., T.A., and Fellowship support. All of our graduate students are supported 11-12 months per year. Our department has endowed funds to provide graduate students with partial travel support to professional meetings and professional development courses and to augment minor research expenditures.

We have used our AGU Bridge Partnership and membership in the IGEN consortium (see section on **Diversity and Inclusion below**) to revise our graduate admission process. We no longer require or use GRE scores in graduate admissions. We have revised our graduate application to better assess student potential using holistic criteria. The department will continue to engage in best practices related to recruitment and retention of graduate students to broaden participation from underrepresented groups.

The graduate curriculum in EES draws on faculty breadth and depth to provide technical training, research skills, and professional development. EES Ph.D. students are required to take one of two currently rostered core courses and tailor their remaining credit requirements to meet their research and career goals. EES faculty engaged in the graduate program regularly offer courses in their area of research expertise. Most faculty teach these courses in a fashion that meets the need for in depth training of their own graduate students as well as the need for breadth within the larger graduate student population. Topical graduate seminars are rostered on an ad hoc basis to accommodate faculty and student interest and needs. EES core courses provide breadth and depth nominally in the two thematic areas of the department: the solid Earth and the environment. In addition to exposing students to core content at the graduate level, the core courses develop quantitative, analytical, research, and communication skills. The courses also cover a range of professional development topics including research integrity, diversity and inclusion, proposal writing, reviewing, the practice of science, and public outreach. In addition to research and course work, Ph.D. students are required to generate a professional development portfolio as part of the Ph.D. general exam.

In many respects, our current graduate program resembles an apprenticeship program. Students are paired with advisors on admission. They generally start research in their first semester and are advised by a single faculty member or co-advised by two faculty members. Given the breadth of disciplinary expertise in our department, students generally develop expertise in their subfield through a graduate level course with their advisor (or co-advisors), hands on research, and through the external research network of their advisor. This exposure provides an important research network for our students during their studies and after they graduate. Student perspectives are broadened through course work in allied fields within the department, giving them breadth that serves them well over the course of their careers. Many faculty are engaged in multidisciplinary research providing broad networks for students post-graduation.

The intellectual environment in EES is enhanced by a weekly seminar series with invited speakers, with a department lunch before the seminar and a follow-up coffee hour. The annual Donnel Foster Hewett lecture series, graduate student research symposium, annual Departmental field trip, and a weekly reading group organized by the graduate students add value to the graduate student experience, intellectual environment, and sense of community.

Current mentoring of graduate students in EES is heavily driven by the primary advisor. We can help generate community and enhance inclusion by broadening the mentoring network to include additional faculty, staff, and student peers. Understanding and mitigating negative experiences in graduate school in the next decade requires an approachable, trustworthy, and accountable support network composed of peers, staff, and faculty.

Specific Actions to improve our graduate program:

- build critical mass in our graduate program; increase the program size to 30+ students, a mix of M.S. and Ph.D. students, prioritizing Ph.D. students, to maximize research productivity and impact (see the record for past years in the **Supplementary Materials**)
- provide a community of diverse mentors, role models, peers, and professionals, to help with a range of issues: developing scientific questions and problem-solving skills, professional development, and mental and emotional health; adopt guidelines for effective student mentoring.
- continue to encourage students to broaden their education and training beyond their specific research
- enhance early career training and access to academic and non-academic skill sets for a range of career pathways
- extend graduate student professional development portfolios to explicitly include student initiative, education and training in issues related to diversity and inclusion
- continue to recruit graduate students from the GEM and AGU Bridge Programs
- reserve 1 Kravis Fellowship each year for AGU Bridge Program applicant
- keep and review graduate student demographic data on an annual basis, including applicants, admits, matriculated students, retention, years to degree, and first employment

Diversity and Inclusion.

- **Goal:** increase diversity in our faculty and staff, graduate students, and undergraduate majors; create an inclusive culture that not only welcomes and supports everyone in our community but enables them to thrive.
- **Actions:** develop a ten-year hiring plan tied to outcomes; establish a “Pathways Initiative”

EES was one of the first departments at Lehigh to explicitly include demonstrated achievement and future potential for meeting the needs of a diverse student community as an explicit evaluation criterion in faculty hiring, on par with evaluating research, teaching, and service. We were also one of a small number of departments nationwide selected through a competitive proposal process for inclusion in the American Geophysical Union’s inaugural Bridge Partnership program to increase the number of students from underrepresented groups receiving Ph.Ds. in the geosciences. Numerous EES faculty regularly engage in education and training workshops at the university and with our professional societies aimed at improving diversity and inclusion in the Earth and Environmental Sciences.

To advance our field, to meet societal needs, and to educate and prepare our students for successful lives and careers, requires that we attract the best people to the Earth and Environmental Sciences. To do this, we need to broaden participation from historically underrepresented groups and ensure that all members of our community are supported and included and reach their full potential. Recognizing that diversity and inclusion are essential, not only to our success in research and education but also to solving some of the most pressing challenges we face as a society, broadening participation in the Earth and Environmental Sciences is a core component of our strategic plan.

A diverse and inclusive environment is key to EES and Lehigh’s success. Diversity includes all the ways in which people differ: race, ethnicity, gender, age, national origin, religion, disability, sexual orientation, gender identity, socioeconomic status, education, marital status, language, physical appearance, ideas, perspectives, and values. We recognize that individuals have multiple identities and group affiliations. Inclusion is the act of creating environments in which any individual or group is welcomed and feels respected, supported, and valued to fully participate. An inclusive climate embraces difference and offers respect in words and actions for all people. In support of the EES Mission Statement: **‘Engagement with diverse perspectives and people enhances our research and is integral to educating our students,’** and to realize the **EES Statement on Diversity and Inclusion**, the department will take the following steps:

- develop and implement a plan to broaden participation and create an inclusive department culture including metrics to assess progress and guide modification as needed
- hold ourselves individually and collectively responsible and accountable for improving diversity and creating an inclusive environment
- include efforts to improve diversity and inclusion as part of annual performance review
- integrate issues of diversity and inclusion across all department operations, decision making, and resource allocation
- make data driven decisions using research and evidence-based practices and demographic and climate data to guide decision making

- establish a ‘Pathways Initiative’ including outreach to South Side schools (e.g., Donegan Elementary, Broughal Middle, and Liberty High Schools) and partnerships with one or more underrepresented minority college/university
- participate in the STEM-SI (Summer Institute) to engage undergraduate students from underrepresented groups in summer research experiences

Keys to success in this area include building diversity in a number of pathways that lead to Earth and Environmental Science. It also includes attracting a more diverse population of faculty, staff, and students to Lehigh. To fully realize a robust ‘pathway initiative’ requires new resources and an effort in EES would benefit from a broader institutional initiative. Diversifying the undergraduate population and enhancing the student experience and success of all Lehigh undergraduates requires institutional commitment and change. Diversifying the graduate population requires elevating the status and level of support for graduate studies at Lehigh including a more robust research infrastructure. Diversifying the faculty and staff on meaningful timescales requires more flexibility and agility than our current hiring structures allow. We need a more holistic approach to hiring and staffing to meet the needs of modern higher education: to restore public trust, to enhance the value proposition of obtaining higher degrees, to meet the needs of our diverse population, and to respond to challenges and opportunities on timescales shorter than an average tenured professor’s career. This requires balancing the value and contributions of tenure track and non-tenure track faculty, incorporating early career post-doctoral researchers and scholars as part of our research and education community and as a pool to tap for future hires, and broadening staff roles to support a more integrated vision of the university where research, education, and community exist within an ecosystem rather than in silos. To this end, our 10-year hiring plan presented below is integral to our strategic goal of broadening participation in EES.

An Integrated Ten-Year Hiring Plan. We outline a hiring plan for faculty and staff to meet our overarching goals: research and education on how the solid Earth, oceans, atmosphere, and life interact to shape the world in which we live, the success of our students, and broadening participation in the Earth and Environmental sciences. Our department is interdisciplinary in approach and our mission and curriculum are broad, providing flexibility and agility with respect to both disciplinary and technical expertise. We note that EES has the potential to mesh with and contribute to a number of institutional initiatives to the extent that these initiatives are well-defined and sustained.

Opportunities to hire are tied to turnover (retirements, resignations) and growth associated with the institution’s plans to increase numbers of students and faculty. We recognize that competition for resources within the college and university is always keen and will be even more so post-COVID. Thus, our hiring plan is tied to outcomes, research productivity, the size of our graduate and undergraduate programs, and non-majors served across Lehigh’s colleges.

We take a holistic approach to hiring faculty and staff rather than a one-by-one hiring approach. Our hiring plan includes both tenure track and non-tenure track faculty, post-docs, and staff over a 10-year period to meet the department research and teaching mission described above and to increasingly support a diverse and inclusive community. The hallmarks of our hiring plan are threefold: **1)** to conduct broad searches for tenure track faculty, **2)** to leverage tenure track faculty turnover in the next 5 to 10 years to grow and build the mix of people (tenure track and non-tenure track faculty, post-docs, and staff) to best support our mission and goals, and **3)** tie

future hiring to measurable outcomes to grow the department. We choose this path recognizing the key role for non-tenure track faculty (teaching and research faculty, Professors of Practice) and early career postdocs in flexibly leveraging needs for improved technical support and the need to cover employment and skills-related training that is most agilely handled by Professor of Practice. Including rotating 2-3 year post-doc appointments in this plan enhances research productivity, institutional reputation, and provides the potential for opportunity hires.

The Need for Broad Searches. It is well documented that broad searches attract the richest and most diverse applicant pools. They also allow us to tap into the best individuals available in a given year. Our most recent searches support this conclusion. Our ads, which in part read: *“Lehigh University invites applications for a tenure track position in earth and environmental sciences... We are especially interested in candidates working across disciplinary boundaries or in emerging areas of earth and environmental sciences whose expertise contributes to department strength”* attracted exceptional, deep, rich, and diverse applicant pools to recruit from. Our ads yielded over 350 applicants. Our long and short lists were exceptional and diverse, yielding multiple candidates that we would be happy to hire.

This strategy allows us to focus on hiring the best people in a given year and to build a more diverse faculty. We hire individuals with the highest potential to build and sustain successful faculty careers over decades. These individuals have the passion and creativity to carry out innovative research over a long career, the ability to successfully educate and mentor students and early career scientists, and the desire to join and support a diverse and inclusive community. This approach helps build critical mass short term and as research and teaching evolve with time, sustain excellence long-term.

Leveraging tenure track faculty turnover to meet mission, goals, and objectives. The decision to retire is an individual choice that takes into account professional, personal, and financial goals as well as health and well-being. While retirement is not linked to any specific age, using CUPA (College and University Professional Association) data as a guide, EES can anticipate that somewhere between a third to perhaps two-thirds of our faculty might retire in the next 5-10 years (**Figure 2**). This includes a number of highly productive faculty in the department. Faculty renewal in EES provides an opportunity to increase diversity and to restructure how we align faculty, staff, and early career post-docs to meet our mission and goals. In addition to other factors, attracting a diverse student body requires diversity in our faculty and staff. Enhancing research productivity and reputation requires a robust research infrastructure that includes human resources and technical expertise. Preparing students for diverse career opportunities requires expertise and networking opportunities not generally associated with tenure-track faculty. Successful mentoring requires incorporating multiple pathways and levels of mentorship from peers to undergraduate and graduate students, post-docs, staff, and faculty.

Our hiring plan (**Table 1**) seeks to use a blend of tenure track and non-tenure track faculty, post-docs, and staff to provide added value to our traditional faculty portfolio to provide flexibility and agility, enhance research productivity, grow our graduate and undergraduate programs, increase grades awarded to non-majors, enhance our ability to contribute to interdisciplinary programs, and improve preparation of students for diverse careers. Professors of Practice can provide professional expertise and allied course work, sustainable links to networking, internships and guidance regarding career opportunities for our students and postdocs. Teaching faculty in areas such as data science, visualization, science communication, and sustainability

can expand our curricular offerings and potentially provide technical support for research and education. Research faculty and postdocs are integral to research infrastructure increasing research reputation and productivity and can also provide technical support. Our department currently includes 15 tenure-track faculty (see the **Supplementary Materials**), 2 technical support staff, and 1.5 administrative support staff. We seek to grow to include 15 tenure-track faculty, 3 non-tenure track faculty, 2 post-docs, 2 technical support staff, and 2 administrative support staff, a net addition of 5.5 positions (**Table 1**). Funds to support this growth come from leveraging faculty turnover (salary released from senior faculty) and/or would be associated with Lehigh's plan to grow the faculty.

Table 1. Hiring and growth in EES over the next 5-10-year period, taking into consideration projected growth in numbers of graduate students, majors, and grades awarded and best-positioning EES for the next decades.

Faculty retirements 1 and 2 – yields 2 tenure track and 1 non-tenure track position

Faculty retirements 3 and 4 – yields 2 tenure track and 1 post-doc

Faculty retirements 5 and 6 – yields 2 tenure track and 1 non-tenure track position

Faculty retirements 7 and 8 – yields 2 tenure track and 1 post-doc

Faculty retirements 9 and 10 – yields 2 tenure track and 1 non-tenure track position

Future hiring tied to measurable outcomes to grow the department. The growth in faculty and staff would be evaluated over the 5-10 year time horizon and tied to growth as measured by:

- increased research reputation and faculty productivity (#s grants, external funds raised, publications, editorships, professional society leadership)
- growth of the graduate program, to a size of 30+ students (mix of Ph.D. and M.S.)
- increase in majors and grades awarded (including in General Education and contributions to interdisciplinary programs)
- student success post-graduation (measures include job in desired fields, graduate schools)
- broadening participation by historically underrepresented minorities.

Examples follow for non-tenure track faculty hires who could provide added value to our faculty portfolio, provide agility, improve preparation of students for diverse careers, and serve as links to networking, internships and career opportunities, and new funding opportunities. Specific non-tenure track hires are not limited to these fields and could evolve as the external landscape shifts.

- | | |
|----------------------------|--|
| — restoration ecology | — natural resource management |
| — environmental consulting | — hazard mitigation |
| — data science | — science communication |
| — non-profit management | — sustainability specialist/consulting |
| — geoscience education | — environmental risk analysis |

Figures

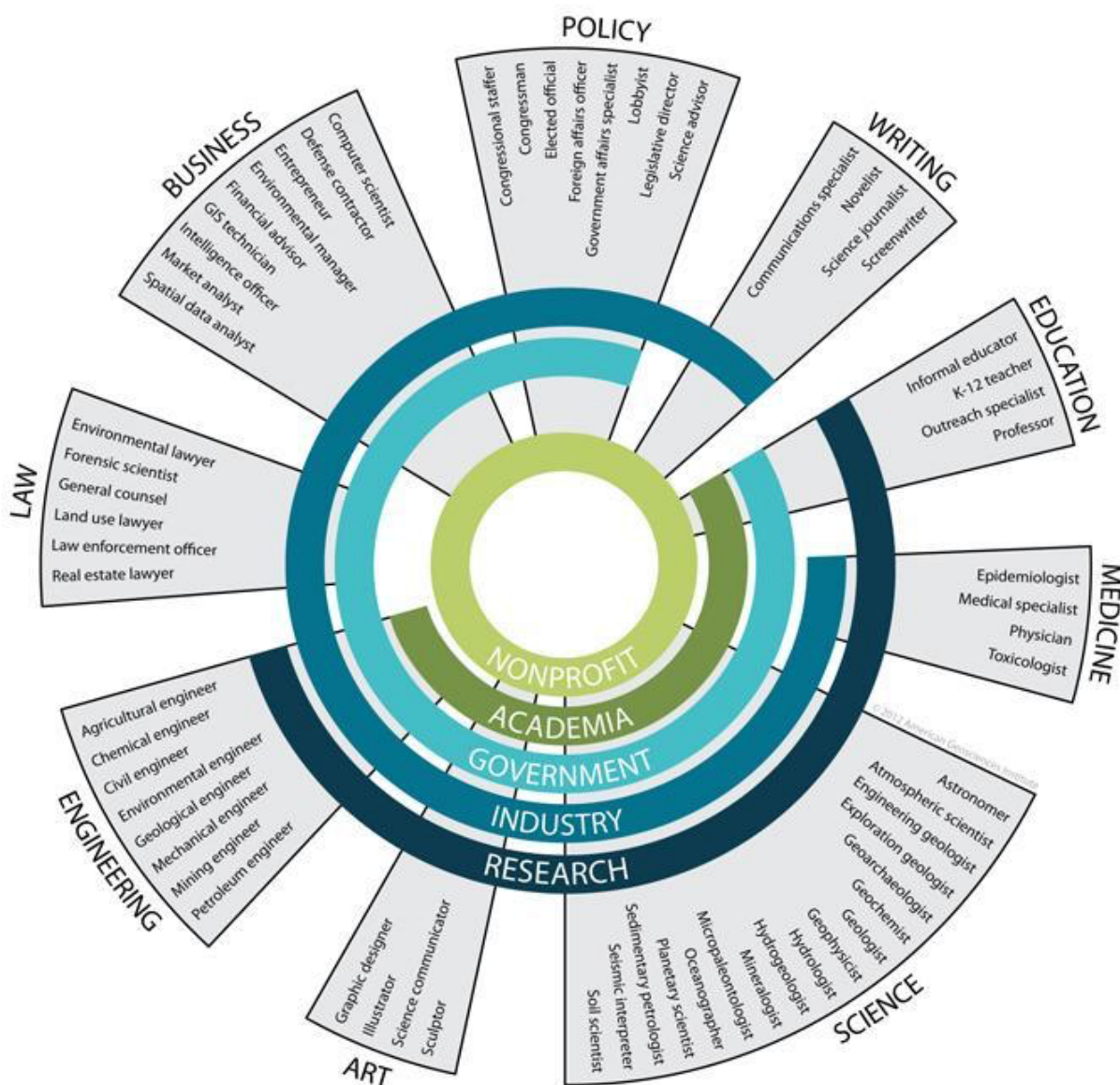


Figure 1. American Geosciences Institute (AGI) infographic as a part of their Preparing Our Workforce (POW) Initiative to help students entering the workforce redefine what it means to have a career in geoscience.

Tenure-Track Faculty Rank and Age Distribution

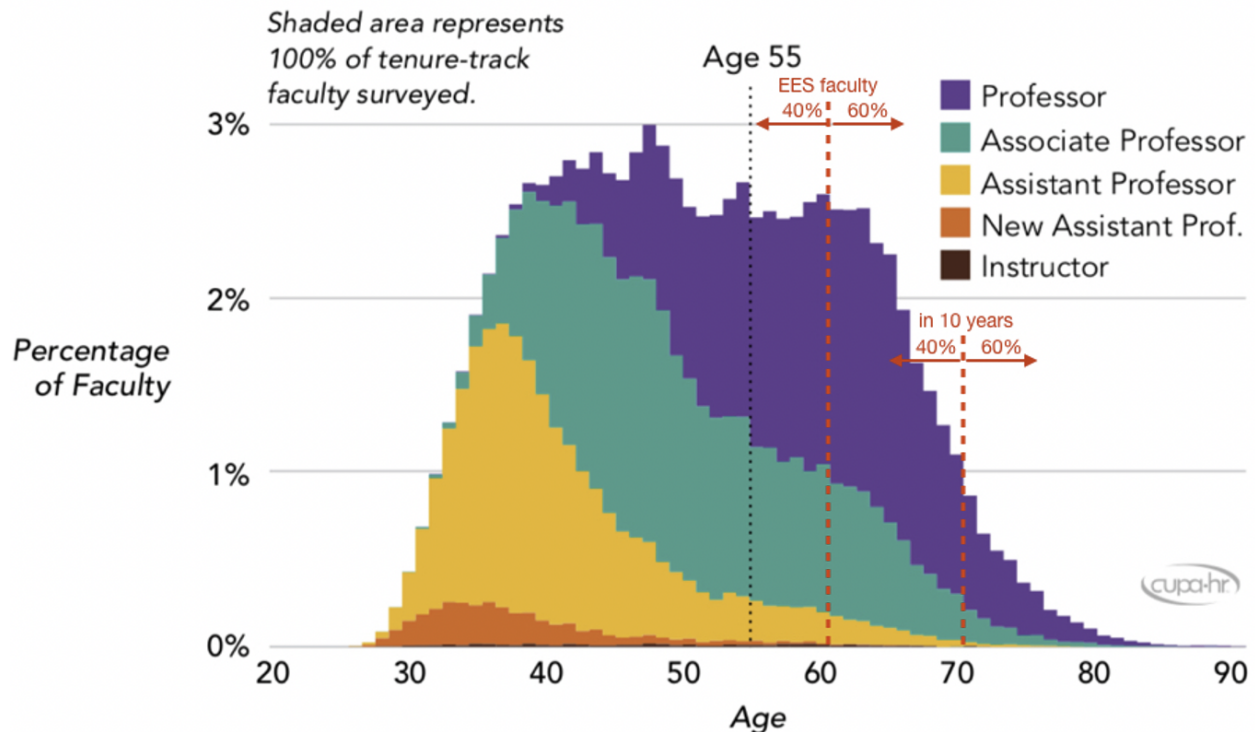


Figure 2. Demonstration of the relationship of age-distribution for faculty in EES with national trends and the progression in ages of current EES faculty over the next 10 years (modified after McChesney et al. (2020)). Between one- and two-thirds of current EES faculty could retire over the next 10 years.

References cited:

- American Geosciences Institute (2021) Workforce Infographic, on the AGU website.
<https://www.americangeosciences.org/workforce/workforce-infographic>
- McChesney, Jasper, & Bichsel, Jacqueline (2020, January) The Aging of Tenure-Track Faculty in Higher Education: Implications for Succession and Diversity (Research Report). CUPA-HR. Available from <https://www.cupahr.org/surveys/research-briefs/>.