The Eberly College of Science strategic plan makes diversity and inclusion one of its marquee values in its vision to become a “vibrant and diverse scientific community that is open and welcoming.” It echoes this interest when discussing trends in the undergraduate applicant pool by noting that, in a little over a decade, applications from international and underrepresented/underserved students have increased, respectively, from 4.4 to 21.1 percent and 15.7 to 22.3 percent. It summarizes these points by concluding, “the nation and world have changed in ways we knew were coming, but it still seems surprising. The future is now!” The plan deftly expresses President Barron’s “diversity and demographics” theme and will be well served by this perspective moving forward.

Obviously, broad statements and focused plans are two different things, and the challenge for the college and, indeed, Penn State in general, is to translate aspirations into attainment. Along these lines, the college has advanced some useful processes, such as its use of the 2012 climate survey to add a subcommittee on graduate student issues and produce guidelines in best practices in graduate student mentoring. The next step is to assess the impact of these initiatives with some targets for performance spelled out beforehand. The college has demonstrated that it understands this facet of planning because, also in response to the 2012 survey, the Climate and Diversity Committee modified some maternity policies, including plans for more lactation rooms and unisex bathrooms. Based on some comparisons between the 2008 and 2012 surveys, it appears these changes brought about some improvement, which were illumined in the plan with data snapshots.

The aim now should be to integrate and expand this procedure: begin with vision, mission, and appropriate benchmarks; establish goals for improvement with assessment plans; specify a set of actions to achieve goals; gauge outcomes against concrete thresholds for success; and reevaluate goals for completion or further improvement. Appropriate use of disaggregated data should guide the process from beginning to end, with goals prioritized to optimize strategic impact. The review team understands that good planning is an investment that must be made over time and that goals must be queued up for completion (assuming balance is maintained and no planning domain is neglected). Some endeavors that are already in place would benefit greatly from this approach, such as Millennium Scholars, STRIDE, PÆRF, the apprenticeship model, associate heads for equity and diversity, tenure clock extensions after the birth of a child, expansions of partnerships with HBCUs, the open house recruiting weekend, and the five STEM special living options. Especially in the aggregate, these and other programs signal a remarkable commitment to diversify the college, and positive outcomes could reveal some programs as best practices. However, gaps remain, especially in assessing impact. Some of the college’s diversity programs have been operational for many years now, but without assessment, how do we know they’re working?

Finally, the plan specifies at least one link between the current plan and the college’s 2010–15 diversity strategic plan, but this practice is not characteristic of the current plan. The 2010–15 plan had numerous goals, action items, and projected outcomes, some of which can be found by comparing one plan with the other, such as climate survey follow up. The current plan should consistently establish these links, at least for key projects, so that the planning continuum is more evident from cycle to cycle.

**Challenge 1: Developing a Shared and Inclusive Understanding of Diversity**

- The college’s attention to a broad appreciation of diversity could be improved. For example, planning appears to be lacking or minimal for veterans and low-income students along with LGBT individuals.
Challenge 2: Creating a Welcoming Campus Climate
• The climate survey revealed that classroom climate remains an issue for underrepresented/underserved students. Focus groups and interventions are the next step.

Representation (Access and Success)

Challenge 3: Recruiting and Retaining a Diverse Student Body
• The positive results reported on more diverse undergraduate applicant pools begs the question of yield. Emphasizing actual enrollment data would give a better picture of desired outcomes.
• The data provided on baccalaureate degrees conferred for women on p. 47 underscore a significant drop in the number of women graduating with chemistry degrees. The plan indicates that the Astronomy Department has been more proactive in recruiting women graduate students, with positive results. Though important differences exist between graduate and undergraduate recruiting, the clear message is that it’s possible to move the needle with concerted efforts.
• The emphasis on planning for the co-curricular experience as a retention tool is welcome. What are the participation rates among underrepresented/underserved students? Targeted programming may be appropriate for these students.
• If outcomes measures validate success, the expanded advising program could become a best practice.

Challenge 4: Recruiting and Retaining a Diverse Workforce
• Despite some progress, the plan acknowledges that the college has a long way to go in diversifying the faculty, especially increasing the percentage of women faculty. This issue is undoubtedly a prime candidate for the robust planning model described in the opening paragraphs.
• The standing faculty search and the promise of quality childcare for new faculty occasioned some questions among the review team. Regarding the latter, how will this goal be accomplished and will it be available for all faculty or any staff members? More details on both undertakings would be appreciated.

Education and Scholarship

Challenge 5: Developing a Curriculum That Fosters U.S. and International Cultural Competencies
• The plan states that online offerings will be expanded and improved. This goal is commendable because it potentially increases access for diverse populations. The college should be mindful of best practices to guard against digital divide concerns.

Institutional Viability and Vitality

Challenge 6: Diversifying University Leadership and Management
• Two of the three associate deans are women. What mechanisms contributed to this accomplishment? Drawing connections between planning and positive outcomes is needed to demonstrate that success is not the result of happenstance.
• With the upcoming search for the dean, the college has a great opportunity to leverage effective planning to increase the chances that the new dean will be a diverse hire.

Challenge 7: Coordinating Organizational Change to Support Our Diversity Goals
• The multicultural coordinator and associate heads for equity and diversity are outstanding structures, and they are able to “sit at the table” in some high-level venues. However, what are their job descriptions and, more importantly, what levers can they pull to drive accountability? Do associate heads receive reduced loads elsewhere so their titles are not mere “tack on” responsibilities? How well do colleagues “buy in” to their roles? These points need to be explicated in strategic plans to ensure that impressive-looking
positions are not largely window dressing. Also, care must be taken to strongly communicate that diversity remains the responsibility of everyone.

- The partnerships with other STEM colleges are noteworthy, and further development is encouraged.

*Response: See Attachment.*
THE FUTURE IS NOW
EBERLY COLLEGE OF SCIENCE
STRATEGIC PLAN
2015-2020

VISION
The Eberly College of Science will be a vibrant and diverse scientific and educational community that is open and welcoming; creative and adaptable; and internationally renowned for excellence in education and research, and for improving the world through its students, discoveries, and outreach.

MISSION
We will advance the frontiers of knowledge in the physical, biological, and mathematical sciences; provide access to a rich educational experience; and share our knowledge, discoveries, and inventions to improve appreciation and comprehension of science and to bring the benefits of science to society.

GOAL
Our goal is to enrich lives, improve society, and address global challenges by producing a diverse population of scientifically trained leaders and innovators, advancing the frontiers of science, translating our discoveries for the common good, and enhancing the public understanding of science.
INTRODUCTION

The Eberly College of Science will promote basic research of the highest quality to advance the frontiers of knowledge, including research that seeks sustainable solutions to society’s most significant challenges related to human health, energy, and climate change. We will continue to build the quality of the faculty and research programs by pursuing our fundamental strategy of focusing on excellence, recruiting and retaining outstanding people from diverse backgrounds, maintaining a welcoming campus climate, and providing excellent facilities and a productive environment. The college will transform the way we educate the next generation of scientists, leaders, and innovators. We will modernize learning spaces, update degree programs and co-curricular learning opportunities, and enrich pedagogy training of faculty and students to elevate the quality of the educational experience and success of our students. We will increase our efforts to develop a shared and inclusive understanding of diversity, diversify leadership in the college, and achieve greater gender balance and diversity in the faculty and student populations. Finally, the college will increase efforts to translate our findings to the public and business sectors. We will enhance our engagement with the general public to foster a citizenry that is sufficiently knowledgeable about scientific issues to participate productively in policy discussion and development. At the same time, we will work with our faculty and students to translate our research findings to the commercial sector more effectively and implement solutions needed for a sustainable future in Pennsylvania, the nation, and the world. We will work to engage the full diversity of talent and cultures that comprise our global society in our research and educational missions.

I. ADVANCE WORLD-CLASS SCIENCE

Science, with its interplay of formal theory and rigorous experimentation, has been hugely successful in both advancing knowledge and improving the human condition. Over the past decade, our Penn State science faculty, students and postdocs have published an average of 1,000 papers a year. These publications are influential, with over 83,000 citations of papers published by members of the college in 2013 alone. Every department in the college advanced in the most recent rankings of programs by the National Research Council and we currently rank among the top ten institutions in the country in the basic sciences.

EXTEND THE FRONTIERS OF KNOWLEDGE

A central mission of the college is advancing the frontiers of knowledge in the basic sciences while valuing and supporting science that has application to solving global challenges and improving the human condition. We will continue to engage in interdisciplinary work and promote and support the highest levels of intellectual endeavor in any area of science regardless of its perceived applicability or evident connection to other areas of research. This kind of grand intellectual adventure is fundamental to achievements in science and part of what defines us. For example, the study of the origin and development of the universe has led to pursuing an understanding of concepts like quantum gravity, dark energy, and new states of matter under extreme conditions; these are things that are extremely unlikely to have any applicability to daily life other than helping to answer the questions, “Where did the universe come from, and where is it going?”

Another grand pursuit, one with obvious potential for application, is the understanding of the human genome and fundamental mechanisms driving evolution. The power of genomics to illuminate all kinds of questions in the life sciences is well appreciated, but the genome—and life—are very complex, so much remains to be understood. The development of sequencing technology has proceeded at an astonishing pace over the last couple of decades—likely faster than any other technological development in the history of mankind—making genomics and bioinformatics a thriving area of fundamental science and a strength of Penn State, in the college, and beyond.

Materials, starting with very basic natural materials, are an essential part of our lives. Increasingly, the technologies we now depend upon and the new technologies we seek in order to deal with challenges in information technology; energy conservation, production, storage and distribution; and many other areas depend upon the development and understanding of new materials. The college is fully engaged in the study of two-dimensional materials including graphene and topological insulators. These materials are intellectually exciting because of their unforeseen emergent quantum properties; in addition, there is a strong indication...
that these materials will alter how we will live in the coming decades. Furthermore, biological and biology-inspired materials are anticipated to play an increasing role in our lives, particularly in medicine. Going forward, chemistry, physics, biology, and mathematics will be increasingly important in advancing fundamental materials research and helping solve challenges for the benefit of society.

These and many other areas of research in science and mathematics are areas of strength in the college that we will continue to support.

BUILD OUR DIGITAL FUTURE
The ability to generate and analyze very large data sets is transforming all fields of science. It is apparent that faster computers and more efficient algorithms will enable new directions of research, new approaches to long-standing questions, and fundamental advances, ranging from nanoscience to the evolution of the universe. Scientists in the chemistry and physics departments are at the cutting edge of materials design for next-generation computing, while those in the statistics, mathematics, and life sciences departments are designing the algorithms and computational tools to analyze the biological and physical science data sets that are being generated and accessed by our faculty.

If Penn State is to continue to address the fundamental questions in science and to make significant contributions to the most pressing issues in health, the environment, and renewable energy, the college must stay at the forefront of the ever-changing and ever-expanding opportunities and challenges provided by “big data.” We will support this effort with targeted hires that will cross-conventional disciplinary boundaries in areas such as quantum information science, materialomics, astrostatistics, systems genomics, and through collaborations with researchers in the social and behavioral sciences.

The ability to probe and query the massive quantities of data now available in all disciplines of science requires expertise and skill sets that are not present in most research teams. This work can be daunting to many of our faculty members who are utilizing mega-data sets resulting from new technologies and which are now available in ever-growing national and international databases. As a result, we will establish a consulting center for processing, integration, analysis, and sharing of very large data sets. The center will provide information and support for using existing and new data resources and tools across disciplines and will identify and promote best practices. We anticipate that this consulting center would be led by faculty members in the college and include some technical staff members, as well as graduate student research assistants who are interested in cross-disciplinary training.

IMPROVE HUMAN HEALTH
Faculty members in the college have highly productive, ongoing research programs in some of the most competitive areas of biomedical research, including cancer biology, neuroscience, molecular medicine, and medical genomics. Moreover, the college has assembled strong teams of investigators who conduct groundbreaking basic research in RNA biology, epigenetics, and infectious disease, and are at the forefront of the next wave of biomedical research. Thus, the college is poised for leadership roles in multiple areas that will lead to innovations in health care and disease prevention and cures. We will continue to support productive collaborative research across colleges, continue to reduce the barriers to collaboration with scientists and physicians in Hershey, and actively encourage the growing number of graduate students with advisers on both campuses to strengthen these collaborations.

Maintaining our leadership in these areas requires that our scientists have access to the newest sequencing, imaging, and other innovative technologies that drive these rapidly advancing fields. The college will partner with the appropriate centers and institutes to acquire and maintain the newest sequencing and imaging technologies as common-use instruments. College faculty are the leaders in developing such analytical tools for sequence data, and the college will continue to support this work. These facilities also will allow Penn State to partner with large health systems that maintain electronic medical records for large numbers of patients and, therefore, enter the new field of predictive medicine. Analyzing these massive databases in conjunction with genomic data will allow quantitative analysis of a wide variety of potential causes and predictors for disease risk. A targeted hire to provide leadership in this enterprise will open the door for many of our faculty members to generate new data, access complementary data, and develop
the tools to analyze data, resulting in a high probability of making discoveries that will change the face of health care.

Penn State is uniquely positioned to become the worldwide leader in the newly developing area of evolutionary risk assessment and management. Much of modern medicine and public health is about attacking the life forms that harm us; however, these life forms are extremely good at evolving, and this counter adaptation is generating some of the most significant crop, animal, and human health challenges of the 21st century. Emergent infectious diseases, insecticide-resistant disease vectors, drug-resistant cancers, herbicide-resistant weeds, and insecticide-resistant crop pests all are examples of the evolutionary battle, which, when lost, is responsible for over half a million deaths annually and billions of dollars in agricultural losses in the United States alone. Our highest priority for new research initiatives is the establishment of a University-wide institute to address the issue of evolutionary adaptation that leads to problems with antibiotics, cancer therapy, insecticides, and herbicides: The Center for Applied Evolution. We anticipate that the center will include scientists and physicians from across the University Park and Hershey campuses with expertise in evolutionary biology; infectious disease; cancer; ecology; and herbicide, insecticide, and pathogen resistance. We will energize the center with targeted hires at the interface of evolution and public health to create the critical mass for this research focus.

STEWARD EARTH’S RESOURCES

Our planet is facing a crisis with regard to energy and the environment. The ever-increasing energy demand of our growing populations and economies cannot be met using conventional resources without inflicting irreparable harm on the planet. The research programs of many in the college are at the forefront of addressing both basic and applied questions applicable to the production and use of renewable energy, energy storage, and the effects of energy extraction and consumption on the environment.

College faculty lead a DOE Energy Frontier Research Center, which studies the structure and genesis of plant cell walls and the conversion of this non-food biomass into biofuels. In addition, the college’s faculty members are conducting basic research on the biochemistry and molecular biology of photosynthesis, with the aim of improving its efficiency, while others are researching electrochemical energy storage and more efficient storage materials. Other teams are working to bioengineer microbes to produce acetate (a plastics precursor) from methane generated from biomass. Thin film photovoltaics, biophotovoltaics, photocatalysis, and photoelectrochemistry are all under study by scientists in the college to help move away from the use of fossil fuels and to enable alternative energy generation and the necessary, more-efficient storage capabilities that will accompany this shift.

We will continue to encourage and support research in these areas with targeted interdepartmental hires and direct support of centers and faculty members who can lead these research initiatives. When these research initiatives are coupled with our plans to streamline and improve the translation of our science to the public arena (Section VI), our impact on the health of the human race and the planet will increase dramatically.

PROVIDE INFRASTRUCTURE FOR SUSTAINED EXCELLENCE IN RESEARCH

Although the recent National Research Council rankings place Penn State science departments among the top in the country, many of our faculty, postdocs, and students, especially those in our physics and astronomy departments, are conducting world-class research in buildings that are woefully out of date. The college’s number-one infrastructure priority is to address the critical need for a new physics building to provide world-class research facilities while simultaneously creating modern, flexible STEM education instructional spaces. Over the past two decades, the Department of Physics has taken dramatic strides toward academic excellence, rising from a National Research Council ranking of 55 in 1995 to 13 in 2010. The department resides in part in a 75-year-old building that is in dire need of upgrades and is hugely inferior to facilities at peer institutions which impedes our ability to retain top faculty members, recruit new leaders, the best graduate students, and conduct world-class research.

II. TRANSFORM THE SCIENCE UNDERGRADUATE EDUCATIONAL EXPERIENCE
Students who enroll in or take courses in a college with world-class scientists and research programs should have world-class educational experiences. With a series of initiatives extending beyond the classroom, we have set out to transform the undergraduate educational experience in the college.

The makeup of the college population has shifted in the last ten years, in ways that reflect increasingly diverse participation in science at all levels. But we can improve recruitment and retention of a diverse student population. The Millennium Scholars program, a cooperative partnership between the Eberly College of Science and the College of Engineering, began in 2013 as an adaptation of the highly successful Meyerhoff Scholars Program at the University of Maryland Baltimore County. The Millennium Scholars program is focused on recruiting and supporting diverse cohorts of outstanding students and developing a shared expectation for excellence and attainment of a graduate degree in science. We view the core program components of the Millennium Scholars program (e.g., cohorts, living/learning communities, developing United States and international cultural competencies, intensive advising, and early engagement in research) as opportunities for scale-up to include all college undergraduates. In addition to fostering the intellectual growth and development of future leaders in science research, the Millennium Scholars program is, therefore, a catalyst for institutional change in the ways in which we welcome and support all students, and in how we define and foster excellence within the college.

FACILITATE LEARNING COMMUNITIES
Learning communities reinforce classroom experiences, provide networking opportunities, and facilitate peer mentoring. Our goal is to include all students in the college in disciplinary or interdisciplinary learning communities. Expanding the learning environment to include informal spaces that promote interactions, team-based problem solving, and community outside of the classroom is key to this initiative, and we will expand the living/learning options available for our incoming students. Beginning in fall 2014, nearly 600 students in five STEM special living options (Freshmen in Science and Engineering, Biome, Forensics House, Women in Science and Engineering, and Engineering and Applied Sciences), together with the Millennium Scholars, will be co-located in two residence halls in Pollock. This location is near the science core of buildings providing us with the opportunity to promote faculty, staff, and student engagement in purpose-designed common spaces.

The co-location of students presents a prime opportunity to facilitate the natural formation of student groups, and we will work to formalize the creation of disciplinary cohorts in our undergraduate student population. We will expand the college’s Welcome Day program by partnering with the newly formed undergraduate club NEXUS, and we will begin to cohort incoming undergraduates by major and match students with a peer mentor on their first day at University Park. Our goal is to establish a robust peer-mentoring network that extends beyond Welcome Day through the first semester by pairing mentors, and their student groups, with faculty members who are teaching First-Year Seminars.

EXPAND INQUIRY-BASED INSTRUCTIONAL LABS AND FRESHMAN RESEARCH
Studies show that early exposure to research is a powerful tool for training and retaining undergraduate students in science. We will develop and offer inquiry-based instructional laboratories for undergraduate students in their first year; this approach will teach students the scholarly practice of scientific inquiry and promote curiosity and ownership, while establishing the fundamental skills necessary to conduct experimental science. New and expanded educational facilities will be needed to support scale-up from the pilot phase to offering the experiences to large numbers of students.

REQUIRE CO-CURRICULAR EXPERIENCES
Co-curricular experiences can be as important for student learning as the traditional classroom. Engaging in research, study-abroad, internships, and peer-led teaching experiences motivates and stimulates students, allows them to apply and practice what they learn in the classroom, builds community and support networks, and leads to a shared and inclusive understanding of diversity. These types of enriching educational experiences have been shown to contribute to increased student persistence and success in science. We intend to work towards requiring 100 percent of our students to engage in at least one significant co-curricular experience, beginning at an early stage in their education. To accomplish this, we need to increase the visibility of these opportunities through a user-friendly website, communicate the importance
of these experiences to our students at regular stages (including before they arrive at Penn State, when they first begin at Penn State, and in the semesters that follow), and lower the barriers to participation. In addition, we will update and propose several undergraduate certificates, including the International Science and the Science Teaching certificates, to provide formal recognition of co-curricular activities on student transcripts.

We also will establish a dedicated director of undergraduate research, who will be charged with increasing the availability and impact of undergraduate research opportunities in faculty research laboratories. The director will coordinate these opportunities, write undergraduate research training grants, and acquire and distribute resources to encourage and facilitate participation of undergraduates in research labs at Penn State and elsewhere. Mentoring undergraduate learning by supervising research projects is an important form of teaching, and we will identify mechanisms to recognize and reward faculty members who train undergraduates in their research labs. We will, in turn, complement these activities by increasing the visibility of undergraduate research on websites and digital signage, in newsletters, and with a college-wide poster session, and we will promote engagement of undergraduates in research with a formal science research distinction certification program (SCIRES) for students who pursue this option and produce a thesis.

EXPAND ADVISING SERVICES
We will expand our college academic advising center so that additional trained advisers will be on the front line helping students navigate the personal and academic challenges of college life and working to retain our diverse student population. Beyond simply advising on schedules, courses, and co-curricular choices, academic advisers help students develop strong study and metacognitive skills to train them how to learn. Professional development opportunities for advisers will be provided so that they can cross-train for multiple programs in the college and also recognize the changing needs of undergraduates from a range of backgrounds, including students in the 2+2 program from the Commonwealth campuses (a group with historically very low retention rates in the college), students typically underrepresented in STEM, veterans, international students, students with disabilities, adult learners, and students who are the first in their families to attend college. This advising team will be complemented by research mentors and faculty members in the student’s major, who provide career and/or graduate school guidance.

INCREASE EARLY RETENTION EFFORTS
We anticipate that the above efforts will have a positive impact on the retention of students in the college and University. However, we need to ensure that we can retain students long enough for the above-described efforts to have an effect. To do this, we will expand our toolbox of early intervention tools to identify students who are at risk and that then allow us to better match modes of instruction and resources that will allow these students to succeed. We will experiment with “drop-down” courses that allow students who are failing a required course midway through a semester to remain in full-time status while becoming better prepared by entering a course that provides greater opportunity for preparatory learning. To complement this, we will expand our current use of early progress reports, seek additional early indicators of academic concerns, and continue to use the practice of placing students who are identified as having met academic difficulties on “academic hold” until they meet with an adviser. We will collect data on the impact of these initiatives on student persistence and success, and continue to explore other early intervention approaches that may significantly impact our retention rates.

UPDATE DEGREE PROGRAM CURRICULA
Reaching higher levels of excellence in undergraduate education will require us to examine and modernize our degree program curricula. All undergraduate program heads in the college are active participants in annual program assessment, and in using these data for evaluation and improvement of our programs. Two of our interdepartmental undergraduate majors—the Premedicine and Science baccalaureate programs—are well positioned to be among the top in the country, and the college will work to achieve this status. We propose to increase the national stature of the Premedicine program by creating a faculty specific to this program, which will considerably extend and formalize valuable curricular and co-curricular opportunities for these students. In addition to identifying faculty members at University Park, we will offer courtesy or adjunct appointments to Penn State Hershey Medical School physicians.
and appropriate alumni. Further, we will expand the numbers of early assurance partnerships both locally and with top medical schools in the country. We also will work to elevate the status of our bachelor of science degree, while maintaining the flexibility in the program that enables many students to complete a degree in the college. Our goal is to modernize the curriculum to include integrated courses from multiple disciplinary perspectives, making this a program of choice for the next generation of interdisciplinary thinkers. We, therefore, propose to reframe our general science undergraduate program as a bachelor of science in Interdisciplinary Science degree. We will also provide support for faculty members who are interested in developing interdisciplinary courses in emerging areas and topics, including interdisciplinary writing and communication courses and integration of ethics in the science curriculum.

PROVIDE INFRASTRUCTURE FOR ENHANCED EDUCATIONAL CAPABILITIES
Elevating the quality of the educational and learning experience of students in the college will require us to improve and redesign learning, advising, and living spaces. Additionally, expanding enrollments in introductory classes and the transformation of the undergraduate experience to include inquiry-based research experiences emphasize the need for additional and reconfigured instructional space. It is critical that we create effective teaching spaces that encourage participation and interaction and that allow for free movement of instructors, assistants, and students.

III. ELEVATE THE QUALITY OF THE EDUCATIONAL EXPERIENCE FOR ALL STUDENTS
Among all colleges at the University, the Eberly College of Science delivers the second-highest number of student credit hours to Penn State students as part of their major degree and general education requirements. We are committed to improve and enhance mathematics, statistics, and science courses for all Penn State students.

SUPPORT FACULTY MEMBERS IN INCREASING EXCELLENCE IN TEACHING
We must transform the classroom experience by rewarding, training, and inspiring all of our faculty members to incorporate research-proven pedagogical techniques into their courses. We will provide pedagogical training for new faculty members as they begin their teaching careers and on a continuing basis in the form of workshops that will be offered annually by the Center for Excellence in Science Education (CESE). The establishment of the CESE in 2010 was an important step in improving teaching and learning; our early efforts have established a community of science and mathematics educators who are changing the ways that we teach and built a network of faculty committed to improving STEM education that extends beyond the college. Our departments and many faculty members are engaged in the development of learning outcomes for academic programs; we will continue and expand this effort with course-level learning outcomes consistent with program objectives. We have also developed a learning assistant program that benefits both the undergraduate learning assistants and the students in courses served by them. We will build on these early accomplishments and accelerate change by providing additional support to expand the center’s activities both to serve all faculty members in the college and to build a national reputation for innovation, research in science pedagogy, and implementation of education reform.

We will support educational innovation with faculty fellowships for educational development, together with a process that recognizes and rewards faculty members, including in the promotion and tenure process, who undertake serious innovation efforts in their courses. Assessing the impacts of these projects will be essential. We will encourage and facilitate disciplinary science education research by the college’s faculty members and work to develop a culture of assessment. In this effort we will seek to partner with the College of Education as appropriate, including exploring co-hires between the colleges. These steps, effectively carried out, will enable Penn State to become a significant force in science education research.

EXPAND AND IMPROVE ONLINE OFFERINGS
While we remain convinced that the on-campus experience is essential for rigorous education and training of the next generation of scientists and a scientifically literate population, online offerings can expand our reach and provide learning opportunities for students who are not able to spend four years on campus. High-quality online cours-
es and digital media can enrich the educational experience for both resident and online learners at University Park and across the Commonwealth.

We propose to expand the impact and scope of the college’s Office of Online Education—as the Office of Digital Learning—by providing and developing mechanisms for expanding the use of digital components, instruments, and materials for our residential and web-based classes. The Office of Digital Learning will work in partnership with the CESE to identify the most promising digital technologies to enhance our resident instruction courses and support faculty members who wish to use them. We will make available resources such as a one-button studio where faculty members can record content for online delivery of material, flipping the classroom, and other course delivery strategies. We will continue to encourage and partner with faculty members who are interested in new opportunities to develop online courses and materials that provide high-quality educational experiences for our students.

In addition, Massive Open Online Courses (MOOCs) of the highest caliber can serve several functions for the college as a result of their potentially wide reach and impact. We will continue to support faculty members who seek to develop high-quality MOOCs for broad delivery that will reach out to and impact learners around the world. Of particular interest is supporting the use of the material developed for MOOCs in innovative ways such that they positively impact, engage, and augment student learning in resident instruction.

ENRICH THE TRAINING EXPERIENCE OF OUR GRADUATE STUDENTS

Education and training of our graduate students is inherently different from training of undergraduate students, and is accomplished primarily by one-on-one mentoring by the dissertation adviser, the dissertation committee members, and the interdisciplinary collaborators of the adviser. We will continue to encourage and facilitate interdisciplinary training of our graduate students. We also will enrich and expand the training experience of graduate students to better prepare them for the diversity of job opportunities available to students with advanced degrees. We will develop and introduce courses for all graduate students in the college that will supplement the skills and training they will obtain in their research groups.

We will target training in a variety of “soft skills” that are important for scientists in both academia and industry, with specific attention to the development and transfer of intellectual property, ethics in research and the workplace, cultural awareness and sensitivity, and communication to the media and policy makers. We will partner with alumni, other STEM colleges, and the Graduate School to provide the content for these courses, as well as continue to pursue student exposure to science careers in industry, government, start-ups, and foundations via internships, alumni mentors, and on-campus alumni speaking engagements. All graduate students will be taught modern pedagogical techniques as part of their first-year training, and upon completion of the training and success as a teaching assistant will be promoted from teaching assistants to teaching fellows.

INSTITUTE BEST PRACTICES FOR GRADUATE STUDENT MENTORING

We have also identified areas in our graduate programs where a college-wide initiative can create a more welcoming campus climate and improve retention and graduate student success. Over the past few years, we implemented new guidelines and best practices for the mentoring of postdoctoral scholars in the college and produced graduate student mentoring guidelines based on best practices identified from around the United States. We will implement these across the college, as well as work to implement the use of myIDP as part of the mentoring process as encouraged by both the NIH and NSF.

INCREASE THE QUALITY AND DIVERSITY OF OUR GRADUATE STUDENTS

Although the research programs of our faculty members and our departmental and intercollege graduate programs rank among the very best in the world, we must continue to improve our ability to attract the best, the brightest, and the most motivated students from around the world. To do this, we must be able to make offers of financial support that are competitive with top graduate programs in the Big 10, the Ivy League, and the top programs on the West Coast. It is, therefore, imperative that we increase the number of Eberly College of Science Distinguished Graduate Fellowships available to recruit the most outstanding prospective graduate students.
To increase recruitment of a diverse graduate student population, we partnered with other STEM colleges and the Graduate School in 2013 to host a fall open house recruiting weekend for prospective students from underrepresented groups. This program contributed to a college record in the number of applications from students of color and a record number of accepted offers to our graduate programs. We propose to continue to support, enhance, and expand this fall recruiting weekend. To financially support an increasing number of minority graduate students in the college, we propose to combine UGF/DGF offers with graduate school minority fellowship funds, and thereby double the number of prestigious awards that we can offer to the very best minority applicants.

IV. INCREASE THE DIVERSITY AND GENDER BALANCE AMONG THE FACULTY

As we continue to increase the diversity in both our undergraduate and graduate student populations, it is also critical that we increase the diversity of our faculty. Although we have made excellent progress in increasing the racial and ethnic diversity of our faculty by adding eight Hispanic faculty members to our ranks since 2011, we still have a long way to go if we hope to have our faculty demographics reflect that of the U.S. student population. Similarly, women continue to constitute only nineteen percent of the total population of our tenure-track faculty. We recognize that this must change, and we will aggressively work toward increasing the proportions of our female faculty members and faculty members from underrepresented groups.

To accelerate the progress in diversifying the faculty, we have established a standing faculty search. This standing search will foster hires of outstanding faculty members of any rank, will facilitate hires of potential faculty members for whom we must aggressively compete against the other top institutions in the world, and will champion hires who are committed to increasing the diversity of faculty members in science disciplines. In order to widely encourage receipt of applications from a diverse pool, all of our departmental searches will be broad, follow Penn State Guidelines for Recruiting a Diverse Workforce, and have input from the college’s associate heads for equity and diversity. In addition, we will again host a Strategies and Tactics for Recruiting to Improve Diversity (STRIDE) workshop to educate more of our faculty members on the scientific literature on implicit bias and why hiring a diverse workforce requires affirmative action.

In town hall meetings with our faculty members, it became clear that in order to attract and retain outstanding faculty members we must maintain a welcoming campus climate and make the college as family friendly as possible. This begins with the communication that we strongly encourage our faculty members to take parental leave and to extend their tenure clocks following the birth or adoption of a child. In partnership with the University’s breastfeeding support program, we will provide our faculty with current information about available lactation rooms and seek opportunities to increase the number of lactation rooms near the science core of buildings. Additionally, the college is committed to work toward guaranteeing faculty members

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ENHANCE POSTDOCTORAL TRAINING AND PREPARATION FOR A DIVERSITY OF JOBS

The NSF, NIH, and many professional societies are emphasizing the importance of more effective mentoring and development of a wide range of skills to prepare postdoctoral scholars for the highly competitive workplace they are facing. Recently, the college has drawn from the best practices from around the country and developed a self-assessment and individual development plan (IDP) rubric (https://elements.science.psu.edu/faculty-staff/postdoctoral-information/IDPfillable.pdf) that all postdocs, in collaboration with their faculty mentors, should complete yearly to assist postdocs in achieving their training goals. We will fully implement and monitor the use of the IDPs by all postdocs (and their mentors) in the college.

To provide the additional training that has not historically been available to all postdocs, we will expand and enhance the postdoc orientation program to include IP awareness and technology transfer training; encourage, facilitate, and monitor postdoc training in ethics; provide expanded opportunities for training in pedagogy; and provide opportunities to obtain both online and residential teaching experience. We will continue to supplement the mentoring/workshops currently offered by the University for postdocs in areas such as job applications, interviewing skills, effective mentoring, and setting up a laboratory, with lunch-hour open houses following the model already practiced by several of our departments.
excellent childcare services for their children ages 5 and under.

V. INCREASE JOB SATISFACTION AND PROFESSIONAL DEVELOPMENT OF THE STAFF
The college is fortunate to be supported by a very talented and dedicated cadre of personnel that comprise the support staff for the departments and college. Despite increasing workloads, unfunded mandates requiring yet more work, and decreasing budgets, our staff is committed to the college and to excellence. In turn, the college is committed to retaining these individuals, fostering a welcoming climate, and working to increase staff members’ job satisfaction.

Focus group meetings to discuss college-wide changes that would result in greater job satisfaction have consistently revealed frustration that changing policies, moving targets (report content and deadlines), and personnel changes make it difficult for the staff to perform at the level they desire and of which they are capable. Potential solutions identified by staff subcommittees and focus groups include access to better training for new hires, more training for new policies and protocols, mentoring programs across departments, and improved vehicles to share best practices across departments. We will address the first two potential solutions at the college level by offering IT training specific to a range of departmental staff positions, and with training specific to all new policies, databases, and protocols. The staff subcommittee of the college Climate and Diversity Committee will be charged to work with our college Staff Advisory Committee to follow a model developed in our math and chemistry departments of training new hires using an apprenticeship model for particular positions and to reinstate quarterly meetings of personnel sharing the same job title in different departments for sharing of best practices.

VI. EXPAND OUR IMPACT ON SOCIETY
Our faculty and their research rank among the very best in the world. They have large impacts in their fields through publications, advisory boards, funding panels and through the excellent undergraduate and graduate students who move on to successful careers of their own. Yet, the impact of our research on society is not commensurate with the quality and quantity of our research findings. Thus, we must improve the communication of our research activities and results to the general public and to policy makers and enhance our impact on the public understanding of science and the important issues facing the planet. In addition, increasing the translation of our research findings from the lab bench to the public sector will greatly and positively increase our impact on the region, our state, the nation, and the world.

ENHANCE VISIBILITY
Our faculty, postdocs and graduate students consistently produce significant advances to the frontiers of knowledge and communicate these advances to their peers through seminars, symposia, workshops, and publications. However, communicating to the general public, media and policy makers, requires a different set of skills. In fact, depending on the audience and the type of communication media, different approaches are needed to produce the most impact. We will proactively encourage our faculty members and students to take advantage of communication training opportunities provided by other units in the University and we will also provide specific training during new faculty and new postdoc orientations and as part of our professional development course for new graduate students on how to speak to the public, the media, and policy makers.

BROADEN THE IMPACT OF RESEARCH PROPOSALS
The National Science Foundation, and increasingly other granting agencies, evaluates research proposals both on their scientific merit and their broader impact. Developing effective plans to broaden the impact of research proposals is often outside the expertise of our faculty members and can be very time consuming. Our outreach office has assisted many of our faculty members with this, primarily by partnering with them in conducting summer camp or other experiences aimed at K-12 children.

We will task our Office of Outreach and Science Engagement to develop more compelling broader impact activities aimed at a larger cross-section of the general public that our faculty members can easily adapt for their grant proposals.
TRANSFER RESEARCH TO THE PUBLIC GOOD

The performance of our college in the area of IP development and technology transfer greatly lags behind that of our peer research institutions. While there are pockets of IP activity within the college, there is a general lack of IP awareness throughout the college that is preventing the research enterprise of the college from fully capitalizing on the economic, educational, and societal benefits of IP development and tech transfer. We will increase the general level of IP awareness and interest in the college and facilitate transfer of our IP to beneficial use by society.

All new faculty members, graduate students, and postdocs will receive an introduction to IP awareness to enable the recognition of potential IP and the steps required to develop and protect it. For faculty members and postdocs this will be provided during the orientation process. Graduate students will receive more extensive training in IP development and tech transfer as a portion of their first-year professional development course. Translating the discoveries of our faculty members to successful business enterprises requires expertise outside of the college. We will partner with OTM and other colleges (the Smeal College of Business in particular) to develop programs, courses, and workshops to both train our inventors and to partner our inventors with Penn State entrepreneurs with business expertise. We will encourage participation in tech transfer workshops and programs offered through the Office of Technology Management (OTM), and will partner with the OTM to develop IP awareness and patenting strategies within the appropriate research centers supported by the college. Reporting on development of IP will be requested in yearly faculty and student activity reports, and the college will celebrate the issuing of patents and the formation of licensing agreements through a variety of internal and external media outlets.

With training and encouragement in the generation of IP, there will be a need for increased mentoring and resources to nurture and facilitate technology transfer from the college’s research labs to the public arena. We propose to further develop our newly formed alumni biotechnology board and to develop a materials science alumni board to provide more of our inventors with access to expertise in IP commercialization and tech transfer.

A major hurdle in the transfer of new technologies and inventions to the public sector concerns the lack of funding sources to enhance the attractiveness of new IP to the commercial sector. Consequently, we will develop a commercialization enhancement fund for translational research (the Laboratory for Translational Research) with the goal of further enhancing the IP generated by the college. In addition to enhancing the commercial value of the IP in the college, these funds also can be used to leverage internal and external translational research funding opportunities. We envision that the fund will be fueled by donations from alumni who wish to see the research enterprise of the college fully capitalize on the economic, educational, and societal benefits of IP development and tech transfer.

This document is a condensed version of the strategic plan for the Eberly College of Science. The full version including the appendix, Progress and Ongoing Efforts to Meeting the Challenges of the Framework to Foster Diversity, can be found at: science.psu.edu/strategic-plan

Information on the assessment strategy and details of our implementation priorities, responsibilities and timeline are present in a separate document: Eberly College of Science Strategic Plan Implementation Strategies and Assessment.