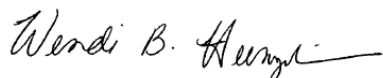


University of Rochester
Proposal for the NAE Grand Challenge Scholars Program

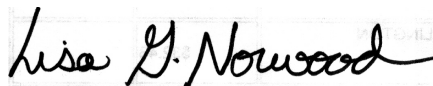
Name of Institution: University of Rochester
Name of School: Hajim School of Engineering and Applied Sciences

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Vision and Goals. Describe the vision and goals for your GCSP program with an explanation of how they fit with the institutional and contextual values and mission.

The Hajim School of Engineering and Applied Sciences at the University of Rochester has a rich history of engaging students in co-curricular activities to enhance their academic training. These experiences include research, community-engaged learning, internships, and global experiences. Additionally, the unique Rochester Curriculum enables Hajim engineering students to delve into areas outside of their main engineering field by engaging in “clusters” of courses in the humanities or social sciences that form a cohesive unit. This philosophy of the importance of a range of experiences and multi-disciplinary learning matches exactly the goals of the National Academy of Engineering Grand Challenge Scholars Program (GCSP). Our vision for the GCSP program on our campus is to provide a cohesive tie among these many experiences within the context of one of the NAE Grand Challenge problems. By integrating the existing offerings with a unified theme, we expect our students will achieve greater benefits from their education and be well positioned to solve some of society’s greatest challenges.

Steering Committee. Describe the recruitment and selection of the membership of your steering committee and their responsibilities

The Hajim School comprises a variety of programs, departments, and institutes, including:

- Audio and music engineering
- Biomedical engineering*
- Chemical engineering*
- Computer science*
- Data science
- Electrical and computer engineering*
- Engineering science
- Interdepartmental engineering
- Geomechanics
- Institute of Optics*
- Mechanical engineering*

The GCSP Steering Committee, which will be led by the GCSP Director Lisa Norwood, Assistant Dean, will consist of a faculty member representative from each of the departments asterisked above, as well as a member of the Hajim School Academic Advising Team. The Chairs of all of the departments are excited about this program and will provide a faculty member for the steering committee. Generally, terms on the GCSP Steering Committee will be for 2 years; however, to provide continuity on the committee, initially we will vary the terms from 2-3 years so that the entire committee does not rotate off at the same time.

The GCSP Steering Committee will meet formally at the end of each semester, and discuss via email issues that arise outside of these meetings. The goal of the committee will be to:

- recruit students
- work with the students to develop their applications
- review applications for the program and select participants
- track student progress
- certify completion of the GCSP goals

The Steering Committee will also engage in programmatic assessment and oversight of the GCSP.

Recruiting. Describe your plans for recruiting GCSP students.

Students will be recruited into the GCSP in their freshmen and sophomore years. During the first three years of the program, we will also recruit students in their junior and senior years who have had many relevant experiences to apply to complete the remaining experiences and achieve the distinction of being an NAE Grand Challenges Scholar. In later years, only students in their freshmen or sophomore years will be actively encouraged to apply for the program.

We will use our extensive freshman orientation program to introduce the GCSP to our incoming students. We will also disseminate information about the application and deadline to apply to our students through our weekly e-Newsletter (called Hajim Highlights), through the Rochester Center for Community Leadership (RCCL), through our Center for Education Abroad, and through the leadership of our undergraduate student societies such as Engineers Without Borders, Engineers for a Sustainable World, and the Society of Hispanic Engineers, as well as through our individual departments.

As we have seen with other programs, sometimes the best recruiters are students who are in or have completed a program. Hence, we will utilize our current GCSP scholars by having them talk about their experiences in the program at information sessions for potential applicants.

We will have two application deadlines, one in the fall at the beginning of December and one in the spring at the beginning of May. The fall deadline is set to allow enough time for students to learn about the program and hear from current GCSP students in the fall semester. In the spring, the goal is to have an application deadline soon after our Grand Challenge Scholars present reflections of their experiences during our annual research symposium.

Application and Selection. Describe your application and selection process for GCSP students, including how students will be mentored, if necessary, through this process, approximately how many students you anticipate admitting each year and the characteristics of those students, such as majors and whether first-year students can apply. Include the ways in which your recruitment processes are consistent with the institutional and contextual values as well as the goals and vision for the program and its diversity. Note that some institutions establish minimum GPA's for participating students while others do not in order to increase the odds of securing a diverse cohort. We encourage programs to aim for the goal of producing 20 GCSP graduate per year, as outlined in the White House pledge (although such a goal may not be practical for smaller institutions and as such should not be viewed as an absolute requirement, but rather a goal for those programs who can reasonably achieve it).

We will develop a simple, on-line application that will gather relevant information. Building off the application for the Pratt School of Engineering GCSP application (<http://pratt.duke.edu/undergrad/students/research-independent-study/grand-challenge-scholars-program>), we will request the following information:

- Name and contact information
- Expected major
- GPA
- Expected graduation date
- The student's choice of one of the 14 Grand Challenges
- An initial plan on how the student expects to meet the requirements of the Grand Challenge Scholar Program—we will develop a template for this plan that the student can complete on-line that will list the 5 components and the options the students can select from (with "Other" being included in all cases to accommodate students who want to propose something new)
- A short essay on "Why I Want to Be a Grand Challenge Scholar"

This will provide us enough information to ensure that the student is serious about wanting to participate in the program and they are committed to the goals of the program. However, it will not be too onerous as to dissuade students from applying.

We will post the names of the steering committee members on the University of Rochester GCSP website, so students with questions about the application process can contact any of the steering committee members to ask questions, seek advice, and work through a plan.

We anticipate admitting 20-25 students into this program each year. Students in their first and second years will be encouraged to apply. We envision there may be students who begin the program in their third or fourth year (especially for students who stay for 5 years to graduate), and while we will not actively recruit students

beyond their 2nd year, we will allow students to apply at a later date and will evaluate their application on its merits on a case by case basis.

Our goal is to establish a diverse group of participants in the program. We will not have a minimum GPA requirement, but we will require that the student maintain “good academic standing” to be accepted into and continue in the GCSP. We will actively recruit students under-represented in engineering through our [STEM-Gems Program](#), and by engaging our affinity groups, such as the Society of Women Engineers, Women in Computing, Society of Hispanic Professional Engineers, and the National Society of Black Engineers. We will also aim to obtain a diversity of majors, and to engage both domestic as well as international students in the program.

Students will be admitted into the program based on the following criteria:

- Good academic standing, which includes all students able to matriculate in courses for the semester
- A clear demonstrated interest in participating in the program, as evidenced through the application essay
- A well thought-out plan for how to meet the criteria of the GCSP, as evidenced through the application material

We anticipate being able to admit all students who meet these criteria into the program.

Faculty Mentors. Describe how you will recruit, educate, support, and assign faculty mentors for your GCSP students. Include specific responsibilities that your mentors must commit to.

Every Hajim School student is provided with a faculty advisor, who will be informed about the GCSP and can encourage their students to participate in this program. In addition, each student will select a faculty mentor based on their research focus area. This faculty mentor will guide the student on the development of his/her research project. Additionally, each student will be provided with a mentor from among the members of the steering committee. This mentor will work with the student to develop his/her plan for meeting the criteria of the GCSP, and will check in periodically (once a semester at a minimum) with the student to ascertain progress towards meeting the goals of the GCSP.

Funding/Support. Describe how your program will be funded and supported. Note that there is no specific funding level required but if you plan for students to study abroad, travel to national GCSP events, engage in research or service or entrepreneurship activities which require funding; if you plan to schedule on-campus events for your students; if you plan for your director and/or dean to

participate in national GCSP events, etc., please indicate how these efforts will be funded/supported.

Funding for this effort will be provided initially through the Hajim Annual Fund, which provides seed funding for new initiatives within the Hajim School. These funds will support the recruiting efforts (food for events, printing expenses for marketing the GCSP, etc.) as well as any costs for the Director and faculty to attend GCSP events and the costs for medals for those students who complete the program.

Student funding will be provided through our existing mechanisms as follows:

- Research funding will be provided through our Xerox Fellows, McNair and REU programs, which all provide students with housing and a stipend to spend the summer working on a research problem.
- Global experience funding will be provided through our existing travel grants. We provide the Hajim International Experience Scholarship to help students take advantage of unpaid international opportunities and for students where finances may be an impediment to them having a global experience. The Center for Education Abroad provides a \$2,000 grant for students who choose an exchange program, and they offer a \$500 travel grant to support study abroad. Additionally students can apply for need based and merit based scholarships provided by some of our third party providers like IES Abroad and the Council on International Educational Exchange (CIEE). Students who receive Pell Grant funding can also access the Benjamin A. Gilman International Scholarship.
- Conference attendance funding will be provided through our existing [Donald Wood Travel Professional Conference Travel Grant](#) that enables our undergraduates to attend professional conferences.

Our eventual goal is to use the GCSP as a donor opportunity to garner additional support for the program from members of our extended community, in particular to support the research, global, and entrepreneurial experiences of our Grand Challenge Scholars. We believe that a number of our alumni and friends will be quite interested in supporting this program.

Unique Aspects. Describe any unique aspects of your program that allow for understanding of the context in which your program is designed and implemented. For example, will students receive scholarships? Will they participate in an on-campus program such as an honors, student ambassador or other special program? In order for students to complete one or more aspects of your program, will you be partnering with EPICS, Engineers Without Borders, University Innovation Fellows, Habitat for Humanity, senior design, freshman engineering, study abroad, service learning, tutoring, or other local organizations or programs? Do you plan to target non-honors students, honors students or some other specific groups?

Students will take advantage of a number of unique programs currently available on campus to meet the five GCSP components.

In particular, we have a number of opportunities for students to pursue **research**, including our Xerox Summer Fellowship program, our McNair program, and several NSF Research Experience for Undergraduates (REU) programs. In all of these programs, students are paired with a faculty mentor and spend the summer working with the faculty member on a research project. Additionally, the students participate in professional development workshops and seminars throughout the summer, with topics such as the responsible conduct of research, communicating your research, and entrepreneurship. Additionally, faculty who hold NSF grants often apply for REU supplements to support one or two undergraduate researchers in the summer. Hence, currently 77% of our students participate in research and/or independent study programs as part of their education.

The University of Rochester Center for Community Leadership along with other University partners has created an initiative for **Community-Engaged Learning** to be a cornerstone to the education of Rochester students. The Community-Engaged Scholarship Program supports students, faculty, and community partners in combining teaching, research, and practice to build scholarship and address pressing issues facing communities locally, regionally, nationally, and globally. Through pursuing an academic citation in community-engaged scholarship, students passionate about integrated learning and responding to community-identified needs are able to design a course of study and practice that complements the Rochester Curriculum and their chosen areas of study. The citation is designed to contextualize abstract theories, develop critical skills, and challenge assumptions that will prepare them for their future at the University of Rochester and beyond.

The University of Rochester has a very active **Engineers Without Borders (EWB)** chapter that has partnered with a community in the Dominican Republic to design and build a water disinfection system to supply a rural school with potable water. University EWB members first went to the Dominican Republic in 2015, when they met with community partners and conducted initial water assessments. They inventoried various local hardware stores to determine material availability and the feasibility of transporting these materials along mostly dirt roads to the school. The second assessment trip in 2016 involved more detailed water analyses and bacterial testing. Once they gathered the data, they created three designs, and submitted these, along with the pros and cons of each, to the national EWB headquarters and to their partners in the Dominican Republic. This past winter, the team travelled to the Dominican Republic to implement their solution, along with their community partners.

The University of Rochester is developing a program and associated space called the **iZone**, which will provide students with programs, services, and resources to explore their ideas and develop innovative projects for social, cultural, community, and economic impact. The iZone space will include collaborative workspaces,

consultation and team rooms, exhibition areas, and computer workstations where students from all disciplines can meet with like-minded peers. Students will benefit from a community of experts—including faculty members, librarians, local business leaders, and entrepreneurs—with whom they can consult for assistance in developing their ideas. The iZone's programs will help students become better prepared to participate in activities offered by the other innovation-focused groups on and off campus. Pilot initiatives include an entrepreneurs-in-residence program; professional development workshops; and a match-making program that connects students with services, mentors, and project partners. The iZone will also create opportunities for students to engage with the City of Rochester community and area organizations, such as High Tech Rochester.

Our ***Kauffman Entrepreneurial Year (KEY) Program*** enables students to delve into the topic of entrepreneurship, which the University defines as "transforming an idea into an enterprise that generates value," implying that the enterprise outlives the creator and that it positively affects others. Qualified students may propose to devote as much as an entire academic year to internships, special projects, relevant coursework, business plan development, research into various facets of entrepreneurship, or analysis of how culture and public policy influence entrepreneurial activity.

5 GCSP Components. Describe the specific activities, curricular and/or extra-curricular, which your students must fulfill in order to satisfy each of the five components of your program, below. (You may want to provide 2-3 options of similar complexity for each component OR you may want to identify low, medium and high level activities for each component with an overall minimum number of high level and maximum number of low level activities OR you may elect to utilize some other structure).

Curricular Connectivity: Students must choose one of the 14 NAE Grand Challenge problems (<http://www.engineeringchallenges.org/challenges.aspx>) to focus on for their participation in the GCSP. This Grand Challenge must be at the heart of how the student completes each of the individual components of the GCSP. For example, for a student who chooses the Grand Challenge, "Advance Health Informatics," the student must perform research in an area related to health informatics; the interdisciplinary component must tie in to health informatics, such as looking at the social, political or ethical issues related to health informatics; the global experience may relate directly to health informatics or inform the student on the global context in which health informatics technologies will need to be developed; and so forth. In this way, at the end of the experience, the student will have a thorough understanding of the problem and insight into solutions for the selected Grand Challenge.

To complete the program, students will need to fulfill the 5 different components of the GCSP, through options laid out below. Students may only use a given activity to fulfill one of the components; for an activity that meets the goals of more than one component, the student may choose which component that activity will fulfill. For example, students who participate in a project through the iZone can use this to fulfill either the entrepreneurship or service component but not both.

At the end of the program, students will need to compile a reflection on their participation in the GCSP, as either a poster that can be presented at the University of Rochester annual spring undergraduate research symposium, or a 10-15 page written reflection. The goals for the poster/written reflection are for students to: 1) coherently tie together their experiences in the program, 2) discuss how these experiences have shaped their understanding of the selected Grand Challenge and the potential solutions, and 3) have an opportunity to think deeply about what they have learned and how the GCSP experiences have shaped their education. These reflections can also be used as models for other students to show them how they might think about their program when preparing their applications.

Research component: Students will fulfill this component of the GCSP through any of the following:

- ***Participating in a summer-long research experience at the University of Rochester or at another institution:*** As noted above, the University of Rochester, through the McNair, Xerox Fellows, and REU programs, engages a number of students in summer research with faculty members across the Hajim School. Students can use these opportunities to develop their research for the GCSP. Additionally, several of our students attend other institutions to participate in programs such as an NSF REU to obtain summer research experience. It is expected in all of these programs that students complete a written report as well as potentially an oral or poster presentation about their research at the conclusion of the program.
- ***Participating in an independent study:*** Another way for students to meet the research component of the GCSP is to complete a 4-credit semester-long independent study (or two semesters of 2-credit independent study) on a topic related to their Grand Challenge problem. This course-based study is overseen by a faculty member and requires completion of a final, graded report at the end of the study.
- ***Completion of a research-based design project through a senior design effort:*** All of our students in our ABET-accredited programs must complete a senior design project. Some of these projects are pure implementation, but a large number require research to find a unique solution to a problem. For those students who participate in a research-based senior design project, where a new concept, idea or design is created and put into practice, this will count towards the research requirement for the GCSP. The Associate Dean of the Hajim School will work with students to determine whether their senior design project meets the standard of a research-based project.

- ***Participating in a research-based project for an on-campus organization such as Engineers Without Borders or Engineers for a Sustainable Environment:*** The University of Rochester supports a number of design-based organizations, including Engineers Without Borders and Engineers for a Sustainable Environment. These organizations engage students in developing research-based solutions to specific community needs. Students who actively participate in the development and design of the solutions, over the course of at least 2 semesters and with clear evidence of the student's individual contribution towards the solution, will meet the research component of the GCSP.
- ***Other related experiences, with approval of the GCSP Steering Committee***

Interdisciplinary component: At the University of Rochester, we have a number of opportunities for students to participate in interdisciplinary work. Students will be able to fulfill this component of the GCSP through any of the following:

- ***Clusters:*** Clusters represent a cohesive set of 3 courses within a discipline, either Humanities, Social Sciences, or Natural Sciences and Engineering. All Engineering students must complete a cluster within either the Humanities or the Social Sciences divisions. Completing a cluster in the Humanities or Social Sciences provides students an opportunity to bridge to the other disciplines that will be essential in helping them provide creative and beneficial solutions to problems. Students who connect their clusters to their Grand Challenge problem, and provide a 3-5 page written discussion of this connection, will meet this component of the GCSP.
- ***Humanities Center programs:*** The University of Rochester Humanities Center provides a number of ways for our students to engage with the humanities. The purpose of the Humanities Center is to enable faculty, students and staff to examine human culture in its myriad forms: literature, language, media, philosophy, religion, history, anthropology, visual and performing arts, and much more. Additionally, the Humanities Center is committed to critical thinking, reasoned discourse, inclusiveness, civility, empathy, and compassion—values that lie at the center of humanistic inquiry and that are essential for a thriving democratic citizenry. In addition to regular speakers and reading groups, the Humanities Center sponsors a series of “Undergraduate Conversations”—informal gatherings at which students can connect with a faculty member and with one another around a topic related to humanistic study, providing their own perspective on the conversation. Students who actively participate in a series through the Humanities Center, such as the Undergraduate Conversations series, attending at least 75% of the activities for that series for 2 semesters, will meet this component of the GCSP.
- ***Courses:*** Students may meet this component of the GCSP through successfully completing one of the following courses along with a 3-5 page written reflection of the connection between the course material and the student's Grand Challenge problem:

- Philosophy 120: Engineering Ethics, taught through the Philosophy department
- Other courses as defined by the GCSP Steering Committee each year
- **Other related experiences, with approval of the GCSP Steering Committee**

Entrepreneurship component: Many University of Rochester students are driven to innovate, through their curricular and extra-curricular experiences. Innovation, which is a key component of entrepreneurship, enables our students to transform their education into something that will create lasting value. Given the interest in innovation and entrepreneurship that exists at the University of Rochester, we have a number of ways that students can meet this component of the GCSP:

- **Citation in Community-Engaged Scholarship:** Through pursuing an academic citation in community-engaged scholarship, students passionate about integrated learning and responding to community-identified needs are able to design a course of study and practice that complements the Rochester Curriculum and their chosen areas of study. To receive the *Citation in Community-Engaged Scholarship*, students must complete community-engaged coursework, two Community-Engaged Scholarship Seminars, and a Community-Engaged Capstone course or project.
- **iZone or Ain Entrepreneurship Center projects:** Students participating in a project through the iZone or through one of the undergraduate entrepreneur clubs (Meliora LaunchPad or University of Rochester Consulting Group) will develop the entrepreneurial skills needed to help them understand how to translate ideas into products. To meet this component, students must enter their project into the annual **Charles and Janet Forbes Entrepreneurial Competition**, which encourages undergraduate engineering students to consider the commercial potential of their design projects or research. Students, individually or in teams, compete by submitting a business plan for a manufacturing or technical business.
- **Kauffman Entrepreneurial Year:** Students must apply and be accepted to participate in the Kauffman Entrepreneurial Year (KEY) program. The intent of the proposed program is to create a new enterprise that generates value or to analytically examine such an enterprise, the value it created, and the processes involved.
- **Courses:** Students can fulfill the entrepreneurship component of the GCSP through successfully completing one of the following courses along with a 3-5 page written reflection of the connection between the course material and the student's Grand Challenge problem:
 - ENT 101 Introduction to Entrepreneurship
 - ENT 223 Planning & Growing a Business Venture
 - ENT 225K: Technical Entrepreneurship
 - ENT 227K Entrepreneurship in the Not-For-Profit Environment
 - ENY 227K: Fundamentals of Social Entrepreneurship
 - LAW 205: Business Law
 - MKT 203: Principles of Marketing

- CAS 360 Leadership in a Diverse World
- CAS 125: Creating an Inclusive Campus Community: Disability, Mentorship and Inclusive Higher Education
- CAS 358 The Leadership Experience

This list will be reviewed annually by the GCSP Steering Committee.

- **External entrepreneurship program completion:** Students who participate in external innovation and entrepreneurship programs will be able to petition to use these experiences to meet this component of the GCSP.
- **Other related experiences, with approval of the GCSP Steering Committee**

Global component: Global experience is essential in the education of our students. There are a number of ways that students at the University of Rochester obtain global experience, both in going abroad for study, internships, research, or field experiences, as well as through on-campus interaction with our global community of scholars. Hence, students can meet this component of the GCSP through any of the following:

- **Study abroad:** 23% of Hajim School students in the Class of 2017 had an international experience in one or more of the following categories: traditional semester studying abroad, service projects, research, or internships. Students are welcome to participate in both UR and non-UR partner programs. We currently have 178 programs from which students choose. We have also joined the Global Engineering Education Exchange Consortium (GE3), which allows us to increase the number of engineering specific study abroad offerings.
- **Faculty-led field experiences:** The University of Rochester provides a number of faculty-led field experiences, that may range from a couple weeks to our latest program to study the castles/slave forts in Ghana (6 week experience). These short-term programs provide students with a chance to experience the culture of the country as well as some of the constraints of developing solutions in that part of the world (e.g., the electricity going out periodically in Ghana; poor roads in areas; lack of internet connectivity, etc.).
- **Global senior design experiences:** Through our partnership with the University of Ghana (UG), our Mechanical Engineering department has developed a senior design program with the Biomedical Engineering department at UG to have students from UR and students from UG paired up to work on developing solutions to the problem for their senior design course. Students meet via Skype to talk about the problem, the constraints both in the US and in Ghana, and to develop solutions that might work in both locations.
- **Engineers Without Borders:** As described above, our Engineers Without Borders team has paired with a community in the Dominican Republic to develop a clean water system for a rural school. A number of students have spent time in the Dominican Republic for the initial assessment as well as for the implementation of their system; plans are underway to return to the Dominican Republic to assess the system next year. Participating in this

program provides students with a valuable understanding of the global context needed for their solution, including the need to use local materials to make sure their solution is sustainable by the community.

- ***On-campus global interactions:*** Students may develop an on-campus opportunity to enhance their global perspective by engaging our growing international population. For example, students may propose a year-long series of monthly conversations on culture, social and political differences, environmental and infrastructure contexts, etc. of different communities around the world and how these differences inform engineering design decisions. Students would need to propose an idea to engage a global community and develop a global perspective on campus; this would need to be approved by the GCSP Steering Committee.
- ***Courses:*** Students can fulfill the global component of the GCSP through successfully completing one of the following courses, along with a 3-5 page written reflection of the connection between the course material and the student's Grand Challenge problem:
 - CAS 170: US Life: Customs and Practices
 - ANT 101 Cultural Anthropology
 - ANT 266 Anthropology of Globalization
 - ANT 268: Science, Culture and Expertise
 - ANT 299: Malawi Immersion Seminar
 - ASL 113 French Sign Language & Deaf Culture
 - CLA 299: Field Methods in Archeology
 - POL 157: Polish in Poland
 - SP 205: Spain: Past Present and Culture
 - FR 157: French in France
 - GER 157: German in Germany
 - HIS 110: The Making of Modern Africa New Perspectives in Global History
 - HIS 299: Archaeological Field and Research Methods
 - TBD Digital Archaeology of Heritage Buildings of West AfricaThis list will be reviewed annually by the GCSP Steering Committee.
- ***Other related experiences, with approval of the GCSP Steering Committee***

Service component: There are a number of options for students to meet the service component of the GCSP, including the following:

- ***Citation in Community-Engaged Scholarship:*** As described above, students can obtain a citation in community-engaged learning through participating in courses and developing and implementing a service project.
- ***iZone:*** Students who develop a service-based project through the iZone will obtain the skills needed to understand the importance of working to help others. Students will have a deepened awareness of the impact of their work on society through the development and implementation of the project.
- ***Engineers Without Borders or Engineers for a Sustainable World:*** The goals of both Engineers Without Borders and Engineers for a Sustainable

World are to engage our engineering students in developing solutions to some of society's most pressing problems. Many of the problems tackled by these groups overlap with the NAE Grand Challenges, and hence students participating in these organizations will gain the requisite skills to understand the benefit of their work to the greater society.

- **Courses:** Students can fulfill the service component of the GCSP through successfully completing one of the following courses along with a 3-5 page written reflection of the connection between the course material and the student's Grand Challenge problem:
 - CAS 202: Introduction to Community-Engaged Scholarship
 - CAS xxx: Advanced Topics in Community-Engaged Scholarship
 - PH 397 Community Engaged InternshipThis list will be reviewed annually by the GCSP Steering Committee.
- ***Other related experiences, with approval of the GCSP Steering Committee***

Mentorship, Support, Tracking and Assessment. Describe how students will be mentored and supported throughout the program, include the ways in which their progress will be tracked and assessed for completion of your program requirements.

Students will select a faculty mentor, with whom they will complete the research portion of their program. In addition, each student will have a mentor from among the steering committee, who will meet with the student at least once a semester to check in and see how the student is progressing towards meeting the GCSP requirements. At the steering committee meetings each semester, there will be a discussion of each student and the progress that student is making towards completing the program. Students found not to be progressing during one semester will be sent a warning letter; lack of progress or contact by the student in the subsequent semester will result in the student being removed from the GCSP.

All students accepted into the program will be required to complete a pre-survey to determine their understanding of and appreciation for both the grand challenge problem they have selected as well as of the importance of addressing the complex and interdisciplinary problems they will need to solve in the future. We will also ask them about the importance of understanding the cultural, political, social, ethical and economic contexts for the solutions they develop. Finally, we will probe their understanding of the need to think about unintended consequences in their design solutions. After completing the GCSP, we will require students to complete the same survey so that we may assess their growth through their participation in the program. We will engage our Director of Educational Effectiveness to help us design and implement the pre and post surveys and to analyze the results. If other institutions have already developed assessment instruments that we can utilize, we would be very interesting in building off this work instead of creating our own assessment instruments.

Recognition. Describe how graduates of your program will be recognized by your institution. (Your director will be required to report all graduates of your program each May to the national GCSP steering committee. Your students will be included in the national press release, as well as receive a letter from the NAE President. You may elect to recognize them in additional ways).

We will recognize students who successfully complete the NAE Grand Challenge Scholars program at our Senior Awards Ceremony, where they will be presented with a medal that they may wear during commencement. We will also create a website for the GCSP and list all scholars who complete the program on this website. Finally, we will list the recipients in our weekly e-Newsletter (Hajim Highlights) that goes out to the entire Hajim School community, including students, faculty, staff, parents, alumni and friends.

Other. Describe any other aspect of your program not included above.

In addition to the Hajim School of Engineering, the University has faculty in the School of Arts and Sciences, the School of Medicine and Dentistry, and the Warner Graduate School of Education and Human Development with interests in virtually every one of the NAE Grand Challenges, making it possible for students to obtain research experience in the Grand Challenge in which they are interested. In addition, the University of Rochester has a number of Programs, Institutes, Centers and Labs that fit well with specific NAE Grand Challenges, as detailed here.

Advance Personalized Learning

The mission of the University of Rochester **Warner Graduate School of Education and Human Development** is to enable educators and education to transform lives and make the world more just and humane. The Warner School aims to

- Prepare practitioners and researchers who are knowledgeable, reflective, skilled and caring educators, who can make a difference in individual lives as well as their fields, and who are leaders and agents of change;
- Generate and disseminate knowledge leading to new understandings of education and human development, on which more effective educational policies and practices can be grounded; and
- Collaborate across disciplines, professions and constituencies to promote change that can significantly improve education and support positive human development.

<https://www.warner.rochester.edu/>

Make Solar Energy Economical

Our **Alternative Energy** program aims to educate and prepare students to enter green technology fields involving sustainable energy generation, distribution and consumption. Students are exposed to a range of technologies including solar cells, wind, biofuels, fuel cells and batteries. The curriculum includes opportunities to

design energy devices and systems, develop computer and data science skills, model and predict energy markets, network with alumni & students, and to perform research supervised by chemical engineering faculty.

<http://www.che.rochester.edu/graduate/alternative.html>

Our ***Solar Splash*** design team each year designs, builds and races a solar-powered boat, providing students an opportunity to contribute to the solar energy field.

<https://sa.rochester.edu/solarsplash/>

The mission of the ***Center for Energy and Environment*** is to develop technology for improved energy systems and to advance fundamental science that promotes understanding of the impacts of energy technologies on the environment and human health. Coming up with alternative energy solutions is a complex, global issue that Rochester researchers are addressing from multiple perspectives. The core research expertise in science, engineering, and medicine forms the foundation for the Center for Energy and Environment.

<http://www.rochester.edu/cee/>

Enhance Virtual Reality

A number of centers and institutes on campus are developing tools and techniques for enhancing virtual and augmented reality. In particular, our ***Goergen Institute for Data Science*** is home to interdisciplinary data science research and the interdepartmental data science academic programs. One emerging area of research within the Institute is in Augmented Reality/Virtual Reality (AR/VR). This emerging area is of interest to a number of our researchers, who are developing not only the hardware to enable AR/VR (including the optics and electronics) but also translating our knowledge of the human audio and visual systems into enhanced AR/VR technology. Additionally, there is interest across campus in utilizing AR/VR for applications ranging from education to medicine.

<http://www.sas.rochester.edu/dsc/>

Reverse-Engineer the Brain

The ***Ernest J. Del Monte Institute for Neuroscience*** brings together internationally recognized brain scientists and outstanding Neuromedicine clinicians under one roof, with the goal being to find new treatments and cures for a growing epidemic of neurological conditions including Alzheimer's disease, stroke, traumatic brain and spinal cord injury, brain tumors, and muscular dystrophies.

The ***Center for Visual Science (CVS)*** brings together scientists from a variety of disciplines with the common goal of pursuing excellence in vision research. CVS consists of over 30 research laboratories that include faculty from a variety of departments. These laboratories represent a diverse range of studies that span the development of the visual system to the interaction between visual perception and memory. Investigators employ an equally diverse set of approaches, from molecular genetics and cellular biology to neurophysiology, psychophysics and engineering.

<https://www.cvs.rochester.edu/>

Engineer Better Medicines

The **Department of Biomedical Engineering** brings together the technical expertise of our Hajim School of Engineering and Applied Sciences with the clinical experience of our University of Rochester Medical Center. In doing so, we have established a cooperative environment that fosters innovations in medicine and health care. The mission of the Biomedical Engineering department is to discover, create, and educate in order to engineer ever better solutions in biomedical research and health care.

<http://bme.rochester.edu/>

Advance Health Informatics

One of the research thrusts of the **Goergen Institute for Data Science** is in advancing health informatics. Using data to predict individual health outcomes on the basis of treatments, genomics, lifestyle, and behavioral factors may lead to some of the biggest advances in healthcare. The University is a leader in tracking and developing methods to control the spread of infectious diseases and is home to a world center for the collection and analysis of cardiac data.

<http://www.sas.rochester.edu/dsc/research/health-analytics.html>

The **Health Lab** is a multidisciplinary collaboration between the University of Rochester Medical Center, the University of Rochester Medical Faculty Group, and Arts, Sciences and Engineering that leverages cloud-based computing & analytics, multifunction sensors, 3D imaging & modeling, and virtual & augmented reality technologies to solve modern day challenges in medicine. The Health Lab collaborates with internal and corporate partners to advance precision health & wellness, data collection & expert systems, electronic health record integration & optimization, and enterprise-level cross platform mobile software development. These solutions not only have commercial value, but in many cases, lead to the spin-out of start-up companies.

Provide Energy from Fusion

A strength of the Hajim School is our connection to the University of Rochester **Laboratory for Laser Energetics (LLE)**. LLE is a unique national resource for research and education in science and technology. LLE was established in 1970 as a center for the investigation of the interaction of intense radiation with matter. LLE is a unique setting where scientists study laser fusion, where atoms of hydrogen are heated so fast by a giant laser that they fuse, creating bursts of energy - the same process that powers the sun and other stars. LLE is the largest unclassified laboratory of its kind in the nation and provides opportunities for students at all stages from high school through undergraduate and graduate students to participate in research related inertial-confinement fusion as well as high-energy density science.

<http://www.lle.rochester.edu/>