

# The University of Iowa College of Engineering



## Engineering Grand Challenge Scholars Program Proposal

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Alec Scranton, Dean

A handwritten signature in black ink that reads "Keri Hornbuckle".

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Keri Hornbuckle, Associate Dean of Academic Programs & GCSP Director

The University of Iowa College of Engineering  
3100 Seamans Center for the Engineering Arts & Sciences  
Iowa City, IA 52242

## **I. Vision**

The University of Iowa College of Engineering's vision is to be recognized internationally for engineering education, research, and leadership to the profession. Our profession must rise to meet many challenges this century; in particular, the National Academy of Engineering (NAE) has identified fourteen "Grand Challenges" which will require innovative engineering solutions, developed in conjunction with professionals from a broad range of disciplines.

The UI College of Engineering recognized the changing needs of the profession several years ago, implementing a new curriculum centered around the theme "Engineering and something more." Each student takes humanities and social science coursework to help them integrate their technical education with the broader framework of society. They also formulate their "Elective Focus Area" (EFA) so that their coursework emphasizes developing a deeper understanding in the field of their choice. Finally, they must participate in a multidisciplinary team experience. Many of our students also participate in the University Honors Program or complete the requirements for Honors in the Major, which involves a thesis of original research to be formally shared with fellow honors students and faculty from a broad range of engineering disciplines.

Implementation of the Grand Challenge Scholars Program furthers our plan to develop the engineering leaders of the 21<sup>st</sup> century. This program will focus our students' efforts on one of the fourteen NAE "Grand Challenges," preparing them to become leaders in tackling the most pressing problems of our times. We encourage a broad interpretation of each challenge to assure future leaders as each challenge evolves. Through the help of a supportive donor, we have established the James R. Whiteley Grand Challenge Scholars Fund to help support their training, both in scholarship and programmatic support.

## **II. Selection of Scholars**

The UI College of Engineering will promote the Grand Challenge Scholars Program to students prior to their enrollment at the university, through the web site and email announcements, in first and second year courses and seminars, and through the engineering "living learning community," a residential hall for engineering undergraduates. Recruitment will occur in two stages, with students first recruited into the Grand Challenges Fellows Program, with modest engagement requirements designed to encourage first-semester students to enter the Program. Fellows seeking a more ambitious level of Challenge-focused professional development will be recruited into the Scholars program.

Admission to the Fellows Program is open to all undergraduate students in the UI College of Engineering. Promotion to the Scholars tier of the program requires continued good standing in the College and a minimum 3.5 GPA. Applicants at each level must identify their Grand Challenge to study, explain their motivation for pursuing the Grand Challenge, describe their plan for completing the program components, and (for Scholars) submit a letter of support from a College of Engineering faculty research mentor whom they must recruit.

Many of the activities which would best train a Grand Challenges Fellow or Scholar (i.e., a study abroad experience, a service learning project, an entrepreneurial endeavor, a set of research experiments, etc.) incur significant financial costs. One key component of the Engineering Grand Challenges Program is

financial support of these activities, through the James R. Whiteley Grand Challenges Scholars Fund. Fellows and Scholars may apply for financial support to help cover the costs of activities which fulfill the curricular training requirements of the Program. Scholars are also eligible for renewable scholarships supported by the Fund, on top of other College of Engineering support the student may receive. This support is contingent on the recipient's satisfactory progress toward completion of their degree program and their proposed program components, described in the next section.

Scholars will be selected by a committee consisting of the Grand Challenges Faculty Advisor, The Associate Dean for Academic Affairs, and the Program Director, who will provide day-to-day administration of the Program.

### III. Curricular Components

The Grand Challenge Scholars Program contains five components through which the students prepare themselves to tackle a Grand Challenge. Students must participate in each of the five components prior to graduation, though their level of engagement in each one will vary. The components are discussed below with descriptions and examples of three levels of engagement (high, medium, and low) for each. Students are advised that a successful application will typically involve a high level of engagement in a couple of components and medium engagement in a couple of other components. Overlap between the components is expected and encouraged, though the level of engagement should be adjusted appropriately. For example, an internship may help satisfy multiple components. Students should contact the Program Director with questions regarding appropriate engagement levels for their plan of study.

**1) Research Experience.** Grand Challenge Scholars must perform research which addresses their chosen Grand Challenge. The research experience must be performed under the supervision of one or more faculty mentors, one of which must be in the UI College of Engineering. The College of Engineering advisor is responsible for confirming the support is available for the project and the scholar's subsequent efforts and productivity on the project. The University of Iowa hosts a wide variety of undergraduate research opportunities, many of which are coordinated by the Iowa Center for Research by Undergraduates (ICRU). Academic credit for these activities may be available through the University Honors Program (143:100 Honors Research Practicum) and individual engineering departments as Independent Investigation. Financial support for undergraduate research activities also may be available through both individual faculty research programs and ICRU, as well as through the Grand Challenge Scholars Program.

- A) (low engagement) The scholar must complete at least 150 hours of research activity (e.g., 10 hours per week for a semester) pertinent to their chosen Grand Challenge to complete this component.
- B) (medium engagement) Larger research efforts count towards higher levels of engagement. This greater degree of effort is typically manifested as a presentation at a meeting of a nationally recognized technical society.

- C) (high engagement) Authorship on a peer-reviewed technical publication or completion of an honors thesis.

Scholars are also strongly encouraged to present a poster at least once at the annual spring Engineering Research Open House.

**2) Interdisciplinary Curriculum.** The Grand Challenges require integration of engineering skills with fields such as public policy, business, law, ethics, and medicine. Grand Challenge Scholars will combine a significant component interdisciplinary topics into their curricular as well as experiential activities. The avenues for participating in and learning from interdisciplinary activities at the University of Iowa are manifold.

- A) (low engagement) To fulfill this requirement, students must coordinate 9 credits of non-technical coursework under a central theme supporting their chosen Grand Challenge. These courses may be taken under the GEC (General Education Course) requirements in the engineering curriculum. An essay discussing this theme and outlining the students' goals for each course must be submitted to the Program Director for approval.
- B) (medium engagement) To fulfill this requirement at a medium level of engagement, students must coordinate 15 credits of elective coursework under a central theme supporting their chosen Grand Challenge. These courses should include at least 6 credits of non-technical suitable for their GEC requirements as mentioned above. These courses should also include at least 6 credits of upper division electives suitable for their Elective Focus Area (EFA). As above, an essay discussing this theme and outlining the students' goals for each course must be submitted to the Program Director for approval. The UI College of Engineering's Elective Focus Area system, in addition to the University's certificate system, provide pre-coordinated curricula which meet this requirement. A non-exhaustive list of examples include:
  - a) The university-wide Sustainability or Wind Energy Certificate is an excellent venue for students to experience a wide array of courses in this area of great societal and global importance. Individual departments have their own sustainability Elective Focus Areas as well. These can provide students with more specific focus topics within the broad sustainability area, such as in energy, water resources, and environmental management areas.
  - b) The Technical Entrepreneurship Certificate is available for students to gain a broad appreciation of the wide range of expertise and knowledge base required for successfully launching and growing innovative ventures. Individual departments subscribe to this certificate within the Elective Focus Area system as well.
  - c) A minor outside of the College of Engineering can be completed within the Elective Focus Area system or general education component; students can focus on other concentrations while integrating those skills with the technical expertise of the engineering curriculum.

- C) (high engagement) To fulfill this requirement at a high level of engagement requires experiential learning opportunities beyond conventional coursework. The experiential learning opportunity must bring together skills from multiple disciplines under a central theme supporting their chosen Grand Challenge. As above, an essay discussing this theme and detailing the ways in which the experiential learning opportunity will support it must be submitted to the Program Director for approval. A non-exhaustive list of interdisciplinary learning opportunities includes:
- a) Activities within the Medical Innovation Group: This group consists of students from the Colleges of Medicine, Engineering, and Business. The objective of the group is to bring together students with interests in learning about and developing ideas centered around medical device and management solutions that can lead to practical implementation/products.
  - b) Activities within the Honors Program and Honors Seminar: High-achieving students from a variety of disciplines share their efforts on a wide range of problems, including areas pertinent to several Grand Challenges.
  - c) India Winterim program: Three-week immersive study abroad courses which are typically based on a theme of interdisciplinary topics (such as socio-economic and technical issues in the developing world.)
  - d) An internship or research experience with a significant interdisciplinary focus: Students can complete an internship or work with faculty in their laboratories performing research that carry significant interdisciplinary content, often with team members from multiple fields.

**3) Entrepreneurship.** To prepare Grand Challenge Scholars to translate invention to innovation and develop market ventures that scale to global solutions in the public interest, students must take part in one of the following entrepreneurial activities:

- A) (low engagement) One introductory class, ENTR:2000 Entrepreneurship and Innovation (plus required pre-req).
- B) (low engagement) Complete a senior design or other class that has an entrepreneurship component.
- C) (low engagement) Enter a Grand Challenge-related project in the Iowa Business Plan Competition or compete for the Hubert E. Storer Engineering Student Entrepreneurial Start-up Award. \*An application which reaches the finalist stage of either competition, or a design project with a particularly heavy entrepreneurship component are indicative of a medium level of engagement.
- D) (medium engagement) Complete the university-wide Technical Entrepreneurship Certificate to gain a broad appreciation of the wide range of expertise and knowledge base required for successfully launching and growing innovative ventures. Individual departments subscribe to this certificate within the Elective Focus Area system as well.
- E) (high engagement) Typically involves completion of more than one of the above options.

**4) Global Dimension.** Each of the Grand Challenges is global in nature; Grand Challenge Scholars must develop a global perspective through one the following activities:

- A) (low engagement) Coursework consisting of GEOG:1090 Globalization and Geographic Diversity and one of the following:
  - GEOG:1070 Contemporary Environmental Issues
  - GEOG:2910 The Global Economy
  - HIST:2403 Western Civilization III
  - HIST:2604 Civilizations of Asia: Japan
  - HIST:2606 Civilizations of Asia: South Asia
  - POLI:1401 Intro to Politics of Russia & Eurasia
  - POLI:1403 Introduction to Politics in Muslim World
  - POLI:1400 Introduction to Comparative Politics
  - POLI:1500 Introduction to International Relations
  - POLI:1501 Introduction to American Foreign Policy
  - IS:2000 Introduction to International Studies
  - IS:2111 Developed and Developing Places
  - IS:2112 The European Union
  - IS:2042 Intercultural Communication
  - IS:3200 Political Economy of International Development
  - LAW:8570 Human Rights in World Community
  - GHS:4210 International Health
  - GHS:3010 Research Design in Global Health
  - \*Other another approved global course
- B) (medium engagement) An internship or research experience with a significant global focus.
- C) (high engagement) An approved international study program.

Each activity should be accompanied by a written justification for how the option will cultivate an advanced global awareness for the student's chosen Grand Challenge.

**5) Service Learning.** A defining feature of each Grand Challenge is the potential to improve the lives of people currently in need. One means for Grand Challenge Scholars to strengthen their motivation to bring their technical expertise to bear on their chosen Grand Challenge is through service learning activities related to that Grand Challenge. Examples of such service learning activities include:

- A) (low engagement) Short service learning course or Hawkeye Service teams (Alternative Spring Break.)
- B) (low engagement) Attend a conference that is thematically related to service. This could include, but is not limited, to the Engineers without Borders or Bridges to Prosperity National Conferences.
- C) (medium engagement) Practicum or research experience over 8-week summer or a regular semester that is thematically related to one of the GSC themes and is service oriented.
- D) (medium engagement) Extracurricular activity of substantial involvement with proper documentation. This could be in any service oriented club or student organization.
- E) (medium engagement) Semester long service learning course.
- F) (high engagement) Typically involves participation in two or more activities such as C, D and E.

**A summary table of these component requirements is included as Appendix C.**

## Appendix C: Graphical Overview of Program Components

	<b>Low</b>	<b>Medium</b>	<b>High</b>
<b>Research</b>	Minimum of 150 hours of research (e.g. 10 hours per week for a semester)	Presentation at scientific meeting	Peer-reviewed technical publication or completion of an honors thesis
<b>Interdisciplinary Curriculum</b>	9 sh of non-technical coursework under a central theme + technical curriculum	15 sh of non-technical coursework under a central theme + technical curriculum, OR minor or certificate	Interdisciplinary experiential learning opportunity
<b>Entrepreneurship</b>	Introductory entrepreneurship course OR senior design project with entrepreneurial component OR entry in a business plan competition	Completion of Technical Entrepreneurship Certificate OR senior design project with significant entrepreneurial focus OR finalist in business plan competition	Multiple activities from “low” and/or “medium” columns
<b>Global Perspective</b>	GEOG:1090 Globalization and Geographic Diversity + 3 SH course from list	Internship with significant global component OR research program with significant global component	International study abroad program
<b>Service Learning</b>	Short service learning course, alternative spring break service learning trip OR service organization conference	8-week service-oriented practicum or research experience OR significant service activity documented by established organization OR semester-long service learning course	Multiple activities from “medium” columns