

Proposal to establish a
Grand Challenge Scholars Program at
James Madison University

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Introduction

James Madison University (JMU) is submitting this proposal to establish a Grand Challenge Scholars Program (GCSP) at JMU. In accordance with the NAE GCSP “Operational Document for Proposing a GCSP at Your School”, this document describes JMU’s vision and intent for its GCSP, how the five GCSP curricular components will be met, and how the GC Scholars will be selected and tracked.

Vision for a GCSP

Established in 1908, James Madison University is a comprehensive university with strong professional programs, including an Engineering program established in 2008. We combine strong liberal arts preparation with a design-focused engineering major. We recognize that the breadth provided by natural science and mathematics, social science and humanities provide critical perspectives needed for the creation of effective technical solutions, but also for identifying compelling needs requiring engineering action. Our program was designed in the 21st Century for the 21st Century needs, and was informed by a variety of sources, including the NAE’s “Engineer of 2020”. We subsequently have threaded design through all eight semesters of students’ coursework, coupled sustainability and engineering management, but importantly adopted a modern project-based pedagogy. In many ways, our curriculum is a strong match to the goals of the GCSP. It also couples well with our university mission to be “the national model of the engaged university, engaged with ideas and the world”. Consequently, there are a variety a university-level initiatives that connect to our GCSP efforts, including the Madison Collaborative: Ethical Reasoning in Action, a very strong Office of International Programs, and an emerging plan for Creativity, Innovation, and Entrepreneurship.

The GCSP provides a strong mechanism for motivating our students to engage even more deeply during their time at JMU. We have the primary elements of the GCSP in place, and we are continuing to hone additional offerings in some areas, as noted below. We expect that many of our graduates will contribute in meaningful ways to solving one or more of the Challenges.

The GCSP is a tide that will lift all boats, not only within Engineering, but broadly across our college. The engaged learning called for in GCSP supports our vision for the pedagogy required by all students to succeed.

GC Scholars will address the most vexing issues of today with innovative ideas and designs that will help people around the world achieve a higher standard of living and quality of life. At JMU, our experience is that people with a variety of backgrounds and experiences must come together to address these problems, allowing consideration from a variety of vantage points. GC Scholars will have the chance to build innovation and entrepreneurial thinking skills, shifting their habits from simple problem solving to opportunity finding, framing, solving and value creation. A critical aspect of the program is that GC Scholars understand their role in a global environment and that their work has an important service component. Finally, GC Scholars will

connect across JMU, with GC Scholars at other schools, and with professionals involved in solving the Grand Challenges in research and industry.

Program Elements:

In this section, we describe how JMU GCSP scholars will fulfill the main components of the program, as described by the National Academy of Engineers (NAE). As noted above, the JMU B.S. in Engineering was designed in the early 2000's with the Grand Challenges clearly in mind. Many of the facets of the current curriculum directly contribute to opportunities for a Grand Challenge Scholars program.

Element 1. Research

All GC Scholars will be required to execute a substantial research project related to a Grand Challenge. Specifically, each GC Scholar will propose a GC-focused research project, team with a faculty member who will mentor the research, and obtain the approval of the GCSP Steering Group before the research is begun. The GC Scholar will submit a final report, endorsed by the mentoring faculty member, to the GCSP Steering Group for review and approval. The research can include student capstone work, Honors research, or independent research. Each GC Scholar will present his or her research via a poster presentation, either through a GCSP research symposium or through existing Madison Engineering traditions in the Fall (Madison Engineering Scholars' Cafe) or Spring (Madison Engineering xChange). As our current research enterprise is driven by undergraduate researchers, this approach will mesh nicely with faculty expectations.

All JMU Engineering students are already required to complete a two-year capstone research project, and students in allied programs have a year-long capstone project. Implementing this component of the GCSP will not be hard because JMU already has strong support for undergraduate research, as noted above. In addition, some students perform research, either in independent studies or throughout the year as paid research assistants. Since our program was designed exclusively for undergraduate excellence, faculty members embrace research with undergraduates, both because they recognize that the value of this high-impact engaged learning, and they appreciate the opportunity to have research colleagues. We would expect that Engineering faculty will supervise the majority of research projects, but faculty from allied programs will also be involved.

Element 2. Entrepreneurship

GC Scholars will execute a practicum project to explore solving grand challenges through entrepreneurial solutions. Specifically, each GC Scholar would propose a GC-focused entrepreneurship plan, team with a faculty member who will mentor the experience, and obtain the approval of the GCSP Steering Group before the practicum begins. The GC Scholar will submit a final report of the experience, endorsed by the mentoring faculty member, to the GCSP Steering Group for review and approval. All Engineering students currently take two semesters of Engineering Management (sophomore and junior years) that serves as an introduction to entrepreneurship, business, and project management. These courses provide a baseline of knowledge on which students can build. GC Scholars will expand on their entrepreneurial experience through one of the following options:

- 1) Completing a project in one of our engineering innovation and entrepreneurial thinking classes (Innovation, Realization, Innovation Exchange, or Social Entrepreneurship), or Venture Creation classes offered by the JMU Center for Entrepreneurship
- 2) Completing four seminars regarding topics of entrepreneurship, business, and/or intellectual property offered regularly by JMU's Small Business Development Center (SBDC).
- 3) Securing an internship or other experience that explicitly involves a high degree of innovation, invention or related activity with an entrepreneur or within an entrepreneurial/start up organization.
- 4) Submitting a design innovation or business plan in one of the many Business Plan, Start-Up Weekend, or Hackathon events held regularly at JMU or in the surrounding area.
- 5) Partnering on an entrepreneurial venture team on or off campus
- 6) Becoming a leader in one of our University Innovation Fellowship circles, sponsored by Stanford's Epicenter
- 7) Creating sustainable organizational change through the Madison Engineering Leadership Program

GC Scholars will be asked to share their Entrepreneurship experience at an engineering seminar, Engineering Career Clinic, or through media display in one of our common spaces.

Element 3. Interdisciplinary Curriculum

JMU's Engineering program embodies the idea of an interdisciplinary curriculum. All students spend approximately $\frac{1}{4}$ of their credit hours on liberal arts coursework, and the Engineering courses, particularly the design sequence, sustainability and systems courses, are taught from an interdisciplinary perspective. Thus, GC Scholars will deeply explore the boundary between engineering and other disciplines. Given that students take design classes in each of their four years, the engagement with this content is practical, deep, connected and durable. Students will be encouraged to pursue electives (within the 33 credit general education course requirement and 9 credit technical elective requirement) in topics that span disciplines and that could add value to their understanding of Grand Challenge issues and solutions. As the program matures, and electives become regularly offered, we will develop lists of recommended classes to guide students.

Element 4. Global Dimensions

Addressing the Grand Challenges in an interconnected world requires that students cross cultural barriers to achieve solutions to our most pressing problems. Consequently, an education that provides the opportunity to work collaboratively with others from around the world is critical. JMU's GC Scholars will complete a global/cultural awareness experience connected to the Grand Challenges to help them put the global aspects of problems they are trying to solve in perspective, and to appreciate the cross-cultural challenges of implementing effective solutions. Scholars will submit a Global Dimensions plan to the GCSP Steering Group for approval prior to arranging the experience. We strongly believe in intercultural experiences as a vehicle to help achieve this objective. Potential activities will include:

- 1) Studying abroad, either for a complete semester or in one of JMU's extended Summer Study Abroad programs
- 2) Completing a summer internship abroad;

- 3) Participating in an intercultural engineering project via JMU's Engineers Without Borders chapter, Alternative Spring Break (a nationally recognized program), Habitat for Humanity or another mechanism
- 4) Any other activity proposed by the student that involves international travel and is approved by the GCSP Committee.

JMU has an abiding commitment to Study Abroad and ~25% of JMU students participate in an international program. We are currently working to raise that number to ~33%. Even in the short history of the Engineering program, students have studied and done projects in Benin, Costa Rica, Kenya, Tanzania, Germany, Egypt and Malta. JMU's Office of International Programs (OIP) strongly supports expanding our efforts in this area, and provides critical logistic support. To enrich our Grand Challenge culture, GC Scholars will be asked to share their Global Dimensions experience at an engineering seminar, OIP event, xChange, or through media display in one of our common spaces.

Element 5. Service Learning

JMU has an award-winning Office of Community Service Learning that leads a variety of campus initiatives, including the Alternative Spring Break program mentioned above. Community service is woven deeply into the Engineering program as both freshman and sophomores have service learning built into their design classes. Our first-year students undertake a semester long project with a community partner (e.g. schools, children's museum, families) to create functional prototypes that resolve their partner's need. In the Sophomore Design class, students are teamed with a local child with mobility challenges; over the course of two semesters they design, build, and prototype a human-powered vehicle that meets the resident's particular needs. This provides an excellent base on which GC Scholars can build.

All GC Scholars will complete an additional community engagement project or experience so that they will be able to both understand the contexts involved in bringing solutions to practice and to also better understand an engineer's responsibility to her/his clients and the public. GC Scholars will submit a Service Learning plan to the GCSP Steering Group for review and approval prior to initiating a community engagement project. Potential activities include:

- 1) Thirty hours or more of community service;
- 2) Participating in an approved Engineers Without Borders, or Alternative Spring Break service trip;
- 3) Completing their capstone design project or other research project with a substantial community engagement component;
- 4) Leading an engineering outreach effort through our Engineering Ambassadors program;
- 5) Another significant community engagement experience.

Selection and Program Management:

Students interested in becoming GC Scholars will be encouraged to apply at any point in their JMU career, but special emphasis will be given to freshmen and sophomores, and the GC Scholars program will be actively promoted in these classes and our start-of-year event (Madison Engineering Launch). Our selection program is based off the process used for applicant selection to our Madison Engineering Leadership Program over the past three years. Our GCSP

will use a mixed method (application plus interview) selection process, led by GCSP stakeholders (faculty and students). Our process will have the following general flow in December of each year:

1. Application submitted
2. Interview with current GCSP seniors (in early years we will use Honors students until we build out our GCSP student body)
3. Student interviewers and GCSP Steering Group discuss applicants based on program goals and values
4. Offers extended

Students will submit an application to the GC Steering Group. An application will consist of:

- Demographic and academic information, such as their major, minors, hometown, etc.;
- A two-page essay describing the student's motivations and interests in engineering, and conceptual solutions for any of the Grand Challenges;
- A draft schedule for meeting program requirements, including deadlines and methods
- An unofficial transcript.
- Two references, including at least one from a proposed engineering faculty or staff mentor;

The last point is important; it encourages students to review faculty research backgrounds and meet with some of them, then secure a letter. The mentor match-making is effectively built in through the process, and as a by-product, strengthens student connection to the engineering community potentially elevating degree program retention. The mentor match-making process is completed in January as described below, serving as a final check for fit and load balance across the available mentors.

The GC Steering Group will work to select a diverse group of students with strong potential to complete the program requirements and show a driving passion for one or more of the Grand Challenges.

If interest in the GCSP is not sufficiently strong among diverse students, the GC Steering Group will work with the CISE Diversity Council and offices on campus, such as the Center for Multicultural Student Services to build diverse student interest in becoming a GC Scholar.

Each GC Scholar will have a contact from the GC Steering Group and will meet with their mentor at least once per semester to discuss the program and monitor progress. Our program aims to build a group of 40 GC Scholars (about 10% of our student body) with at least half of our faculty serving as mentors (note: all of our engineering faculty are currently mentoring undergraduate researchers). If our engineering program is to truly benefit from the GCSP, then its lessons must not only be infused into the classroom and the culture, but the opportunity must be open to all students capable of succeeding in the program; therefore, we do not intend to set a maximum program capacity.

We will hold a showcase each year to feature the GC Scholars and seniors will be expected to share their work via a display, poster, or oral presentation. Display presentations will be installed in one of our public spaces for long-term interactive use by visitors. In addition, each GC Scholar will be required to create an e-portfolio that will be featured on our GCSP website. This website will provide information regarding the various aspects of the program for potential applicants and interested alumni, as well as provide GCSP underclassmen with examples of how past GC Scholars have been successful.

Our GCSP will be guided by a Steering Group comprised of three engineering faculty. Because of the nature of the faculty we recruit, we have a deep pool to draw from for both the Steering Group and Scholar mentors -- all JMU engineering faculty have substantial experience in four of the five program elements (research, service learning, global, interdisciplinary), and more than half of our faculty have experience with entrepreneurial enterprises. Importantly, our faculty prioritize working with undergraduates on projects and research; all are interested and skilled at doing so. Our reward structure is also aligned with such activity. Steering Group members will serve for three years (other than our startup committee which will have staggered services of 1, 2, and 3 years). One new member will rotate on each year, with each member serving as chair of the committee in their third year of service. The engineering department head will serve in an ex officio role to offer continuity, alignment with departmental mission, and access to resources.

Key elements of the management plan include building new cohorts (mostly first-year students) annually, and working with existing students (mostly sophomores, juniors, and seniors):

New Cohort

- August – GCSP promotion at Launch event
- September – GCSP pitch to ENGR101 class
- September – Open invitation to Engineering Career Clinic for GC Scholars panel session
- September – Open invitation to service organizations info session
- October – Open invitation to Scholars' Café for GC Scholar research talks
- October – Open invitation to International Engineering seminar for GC Scholar global session
- November – Call for GCSP applications
- September through November – Meet the Engineering Faculty sessions in ENGR101
- December – Deadline for GCSP applications
- January – New GSCP cohort kick-off meeting
- January – Mentor matching
- March – submission of final draft schedule for meeting program requirements to Steering Committee
- April – approved plan for meeting program requirements, public sharing of plans at xChange
- January through April – monthly meetings, all mentors and all GC Scholars

Existing Cohort

- August – Assisting with GCSP promotion at Launch
- September – Assisting with GCSP pitch to ENGR101 class via Scholar Narratives

- October – Assisting with engineering student recruiting at JMU Open House
- October – Presentation of research at Scholars' Café
- October – Share international experiences at seminar
- September through April – Meet monthly with GCSP cohort, monthly with mentor
- February – Assisting with engineering student recruiting at JMU Choices event
- April – Presentation of key GCSP work at Madison Engineering xChange
- April – Submission of GCSP progress form to GCSP Steering Group
- May – Awarding of GCSP graduates

Our mentor matching will parallel our system used in matching for our two-year long capstone projects teams with mentors. The system permits both mentors and mentees to express interest in candidates, and matching is achieved through a combination of professional interests and professional practices (e.g. workstyles, mindsets, time availability, etc.). For the GCSP, initial mentor interest is ascertained through the reference letter process, then confirmed in January through group meetings of the new cohort and faculty. Although our mentoring process is based on voluntary participation by faculty, we anticipate setting an upper limit of five GCSP advisees for any one faculty mentor to preserve quality relationships throughout the experience.

Baseline responsibilities for mentors include monthly meetings with their GCSP students to plan and review work and progress through the program. Mentors will also be expected to connect students to GCSP opportunities connected to their domain of expertise (e.g. research projects, electives, etc.). A one-page end-of-year progress form indicating accomplishments and future work for the five elements will be submitted at the end of each academic year for review by the GCSP Steering Group. Successful completion of requirements will result in a presentation of graduates at the Madison Engineering Senior Banquet, and the awarding of graduate cords to be worn at the College of Integrated Science and Engineering graduation ceremony.

As many of the GCSP features capitalize on a mix of existing practices, events, traditions, and expectations, our management system integrates nicely into our engineering program, requiring few additional resources, except mentoring time (which will be a widely shared responsibility). Our close proximity to Washington, DC also provides numerous opportunities for faculty and students to engage with NAE, and national GCSP meetings, helping drive program awareness, enthusiasm, and best practices.

Resource Plan

Nearly all of the pieces are in place to start the GC Scholar program in Fall 2016. While we need to identify the faculty who will staff the GC Steering Group and develop a website to publicize the program, these efforts will easily mesh into our faculty currently leading our Pathways to Innovation, Honors, Madison Engineering Leadership, and other synergistic programs. The Department of Engineering has resources within its budget to support the various facets of the program described above, many of which are already built into the current learning enterprise. We do intend to catalyze our GCSP efforts by shifting a few key resources, though.

Engineering will focus five of its Madison Engineering Changemaker Scholarships on students indicating an interest in becoming GC Scholars, offering an easy early promotion of our GCSP at

recruiting events. These four-year scholarships carry annual academic and participation expectations that align perfectly with the GCSP. This will enable a strong awareness on the program and its learning community from a student's earliest encounter with us, as well as building a strong core of high achieving students. Our engineering building is mid-way through a two-year renovation to align our physical spaces with our project-rich learning experiences. Dedicated first-year, sophomore, junior, and senior design studios, research suite, and passion project studio provide a base of operations for GC Scholar work. Several intentionally designed public spaces will provide venues for displays, interactions, and promotion of student work and the GCSP. Recent alumni gifts to engineering have been allocated to engage students and faculty not only on campus, but also with peers around the world. We anticipate positioning appropriate resources for broad participation of our GCSP at the GC Summit, and other beneficial venues for collaboration.

Closing

The Grand Challenge Scholars Program is well-aligned with the James Madison University Engineering department, curriculum and culture. We stand ready to launch a Grand Challenge Scholars Program at JMU that will help our students connect the Grand Challenges with their education, their career, their public service, and their lives.