



Oklahoma State University - NAE Grand Challenge Scholars Program

VISION:

Oklahoma State University's Grand Challenge Scholars Program (GCSP) is implemented to enhance the global understanding of engineering students in the [OSU College of Engineering, Architecture and Technology](#). The [Nationals Academy of Science's 14 Grand Challenges for Engineers](#) and the [United Nations Sustainable Development Goals](#) are at heart of the next generation's impact on the world. The broad possibilities of a new generation of diverse leaders that are focused on the complex issues of the Grand Challenges provide global educational possibilities, entrepreneurial research alternatives, service learning opportunities, and leadership development for our next generation of graduates. The OSU Grand Challenge Scholars Program will join other national programs in committing to educate and provide experience to leaders that bring the engineering challenges of global societies into perspective and work to solve problems that bring about an improved world.

Innovation, social responsibility, sustainable development, and lifelong commitments to the challenges facing the world in the 21st century are key components of a world-class leader. The technical skills, breadth of values, and global experiences needed to facilitate such leadership are encompassed in the vision of the OSU Grand Challenges Scholars Program.

MISSION:

"Our mission is to provide a diverse population with a quality education in engineering and engineering technology. OSU develops ethical leaders that promote economic and community vitality with technical knowledge, innovation, and communication expertise that connects scientific research, professional education, technical assistance and scholarship to industry, the State of Oklahoma, the nation and the world. The OSU Grand Challenge Scholars Program (GCSP) will amplify this mission by creating a greater awareness in our engineers to the challenges that face our world and the next generations.

BACKGROUND AND PREPARATION:

The College of Engineering, Architecture and Technology (CEAT) at OSU is already actively engaged in the curricular components represented by the program; however, GSCP students, in cooperation with faculty mentors, industry, and government, will begin leading the expansion of the tenets of the Grand Challenges through industry backed design projects, GCSP focused research efforts, scholarly publications, and enhanced leadership training that recognizes the diversity of both our nation and the global community. With the formal implementation of the GCSP, OSU will focus one of its scholars programs on an

interdisciplinary educational target that integrates research, entrepreneurship, and global understanding, attracting a diverse cohort of students who will embrace innovation and collaboration in sustainable, affordable and context embracing engineered solutions to global issues like those outlined in Table 1.

Table 1: Global Challenges for the next generation of engineering professionals.

NAE	UN
Grand Challenges in Engineering	Sustainable Development Goals
Energy and Environment	
<ul style="list-style-type: none"> • Make solar energy economical • Provide energy from fusion • Manage the nitrogen cycle • Provide access to clean water • Develop methods for carbon sequestration 	<ul style="list-style-type: none"> • Ensure access to water and sanitation for all • Ensure access to affordable, reliable and sustainable energy for all • Ensure sustainable consumption and production of natural resources • Take action to combat the impacts of climate change
Health	
<ul style="list-style-type: none"> • Advance health informatics • Engineer better medicines 	<ul style="list-style-type: none"> • End Poverty in all forms • End Hunger, achieve food security • Improve nutrition & sustainable agriculture
Security and Society	
<ul style="list-style-type: none"> • Restore urban infrastructure • Prevent nuclear terror • Secure cyberspace 	<ul style="list-style-type: none"> • Build resilient infrastructure and promote sustainable industrialization • Participate in global partnerships for sustainable development
Learning and Computation	
<ul style="list-style-type: none"> • Reverse engineer the brain • Enhance virtual reality • Advance personalized learning • Engineer the tools of scientific discovery 	<ul style="list-style-type: none"> • Ensure inclusive and quality education for all

This operational plan sets forth the principles by which students are selected and mentored in the program, as well as the requirements they must meet to be designated a Grand Challenge Scholar. The plan also addresses the funding of the program and the integration of the program with potential honors college students in engineering.

Grand Challenge Scholars Program Operations

STUDENT SELECTION:

Students interested in the Grand Challenge Scholars Program must have demonstrated academic excellence within the college (minimum college GPA of 3.2 with at least 18 CEAT credit hours) to apply, as academic achievement is an important component of success in any of our scholars programs. However, the student's response on the proposed GCSP portfolio and evidence of a commitment to the program will be major factors in considering prospective applicants. To apply for the Grand Challenge Scholars Program at Oklahoma State University, each student must meet the following requirements:

1. Have professional school standing in the College of Engineering, Architecture and Technology with a least 30 semester credit hours remaining until graduation,
2. Complete an application form and have a valid passport,
3. Submit a commitment form from the student's GCSP Mentor, and
4. Propose a GCSP portfolio described below encompassing the five required components in the [NAE Grand Challenge Scholars Declaration of Principles](#).

The application and proposed portfolio must be submitted to the GCSP Director before the start of the final 30 credits and before the start of a senior design course or Honors Thesis. The GCSP portfolio must address the required components of the GCSP and the following items:

- The Focus Area,
- Research/Project Component (a plan or prospectus), and
- One page statement that ties together the components to the focus area.

The GCSP Oversight Committee will review all applications and recommend students for admission to the program based on portfolio submission, faculty mentor's recommendation, and scholastic standing. Successful candidates will be notified of their acceptance to the program within 30 days of submission. Based on the initial \$1 million endowment, the GCSP expects to maintain 20-50 students per year and graduate ~20 GCSP Scholars per year.

To remain in the program GCSP Scholars must:

1. Meet at least twice a semester with their GCSP Mentor,
2. Submit a progress report (once a semester) to their GCSP Mentor, to be signed and forwarded to the GCSP Director, outlining their accomplishments for the past academic semester and detailing their plan for the upcoming academic semester,
3. Attend GCSP Seminars/Presentations at least twice a semester, organize one before graduation.

4. Present their research project at a summit, symposium or at the National GCSP Summit during their senior year of school.

Before or during the final semester of study, GCSP students must:

1. Submit a final report (10-20 pages) or Honors thesis to the GCSP Committee verifying the completion of the Plan,
2. Forward a signed letter of completion from their GCSP Mentor to the GCSP Director,
3. Conduct a capstone or Honors presentation to share their experiences and information about the Grand Challenge Scholars Program.
4. Submit a GCSP exit interview form on the program's impact and potential changes in the program.

The final report should define the means of the completion of each of the five curricular requirements of their plan and the overall focus of their work, describe the breadth and depth of their specific program. The GCSP capstone presentation must be completed within the last two semesters of the student's remaining time in school. This presentation should summarize the completion of the requirements, the research/project component. It is expected that students in the GCSP will present their work and network with other GCSP scholars at one of the local or regional GCSP Summits or research symposia in order to connect with students in the GCSP from other engineering schools. The final GCSP portfolio or completion checklist must be completed by the close of the semester in which the student graduates.

GCSP MENTOR:

Each applicant must select a GCSP Mentor (i.e., engineering faculty member) who will guide the student through the entire GCSP Scholars program. The mentor will review the student's initial portfolio and submit a letter of commitment with the student's application to the Oversight Committee. Scholars are required to meet with their mentors every semester to provide progress updates on their present program and to plan for the next semester's goals. Upon conclusion of the program, the GCSP Mentor must write a letter of completion to the GCSP Oversight Committee in support of the GCSP application to be named an Oklahoma State University Grand Challenge Scholar. Once identified, all prospective GCSP Mentors will be given guidance on the Grand Challenges, select UN Sustainable Development Goals and the GCSP prior to submitting the letter of commitment.

REQUIRED GCSP PORTFOLIO COMPONENTS:

The importance of a student's experience in the Grand Challenges Scholars Program is based upon the completion of the 5 curricular components, tied either specifically or thematically to Grand Challenge or select UN Sustainable Development Goal focus topics. Scholars are required to undertake one breadth requirement in each of the following five (5)

components: Research, Interdisciplinary Curriculum, Entrepreneurship, Global Awareness, and Service Learning. For depth, scholars will be expected to complete two or more requirements in three of the listed curricular components. The interdisciplinary component is a mandatory depth area for all scholars at OSU.

For the second and third depth component, students must choose to complete more than one evaluation or critique elements in two of the four remaining components:

- Research
- Global Awareness,
- Entrepreneurship, or
- Service Learning.

(See Appendix A for the outline of Portfolio). The curricular components and their individual requirements are addressed below:

□ Research

Each GCSP Scholar must prepare to help develop effective and economical solutions to one or more of the engineering grand challenges or select UN Sustainable Development Goals that this nation and the world face. Each GCSP Scholar must complete a GCSP Capstone experience or Honors thesis and take advantage of one or more of the following:

- Engage in a minimum of one semester of undergraduate research in an approved team or individual research or design project with a university faculty member, focusing the research on one of the grand challenge themes including a presentation of their findings/experience and an evaluation of their research by a faculty research supervisor. This may include any of the following programs:
 - [Freshman Research Scholars](#)
 - [Wentz Research Scholars](#)
 - [Niblack Research Scholars](#)
 - [NSF REU](http://www.nsf.gov/crssprgm/reu/reu_search.jsp) http://www.nsf.gov/crssprgm/reu/reu_search.jsp
 - [Crowdfunded Undergraduate Research with PhilanthroPete](http://scholardevelopment.okstate.edu/undergraduate-research/crowdfunding-undergraduate-research) <http://scholardevelopment.okstate.edu/undergraduate-research/crowdfunding-undergraduate-research>
 - [Extramurally Funded Directed Research](http://www.ceat.okstate.edu/research) <http://www.ceat.okstate.edu/research>
- The students can register for an independent study research course, directed by a faculty member, or perform the research in an industry or government lab. Prior to conducting the research, the students will provide a written scope of the work to be performed during the semester(s). The prospective work must be approved by the instructor/researcher, the student, and the student's GCSP

Mentor. In addition, the students will be required to present their findings in a poster exhibition at one of the university's undergraduate research symposiums or at a professional meeting.

- Completion of an entrepreneurial product or process development project approved by the instructor, the student, and the student's GCSP Mentor focusing on a grand challenge theme. The students will also be required to present their findings in a poster exhibition at one of the university's undergraduate research symposiums or at a professional meeting.
- Completion of an Independent Study research project approved by the instructor, the student, and the student's GCSP Mentor focusing on a grand challenge theme. The students will also be required to present their findings in a poster exhibition at one of the university's undergraduate research symposiums or at a professional meeting.
- Work experience, for a minimum of one summer or one semester, as a research or laboratory assistant under the direction of a university faculty member or industry research director. The students will also be required to present their findings in either a paper or poster exhibition approved by the faculty member or industry partner and the GCSP mentor.

❑ Interdisciplinary Curriculum

Each GCSP Scholars must prepare to work at the boundaries of public policy, business, law, ethics, human behavior, medicine, and risk as well as other sciences. Each GCSP Scholar MUST take advantage of one or more of the following:

- Approved interdisciplinary program with a minor outside of engineering
- 3-month or more Internship with an interdisciplinary focus in one or more of the GCSP topics (approved by GCSP Mentor)
- 1 academic year or 3-months summer research experience with an interdisciplinary focus that engages non-engineers
- Non-Engineering General Education Course(s) relating to a Grand Challenge theme (see Appendix B for examples)

❑ Entrepreneurship

Each GCSP student must be capable of translating invention and innovation into market ventures and possibly global solutions required for the public's interest. Each GCSP Scholar must take advantage of one or more of the following:

- Approved entrepreneurial experiences (approved by GCSP Mentor & program oversight committee) including startup activities with [Cowboy Technologies](http://www.cowboytechllc.com/about-us) <http://www.ok.gov/ocast/>, the [National Veterans Entrepreneurship Program](http://riata.okstate.edu/veterans/) <http://riata.okstate.edu/startup/hatchery/> <http://riata.okstate.edu/startup/incubator/> <http://riata.okstate.edu/startup/accelerator/>
- Internship with a significant entrepreneurial focus (approved by GCSP Mentor & program oversight committee) <http://riata.okstate.edu/internship/>
- Research experience with a significant entrepreneurial focus (approved by GCSP Mentor & program oversight committee) <https://tdc.okstate.edu/cowboy-technologies>
- Approved Course(s) or Bootcamps which focus on entrepreneurship

❑ Global Awareness

Each GCSP Scholar must develop the perspective necessary to address challenges that are inherently global as well as to lead innovation in a global economy. Each GCSP Scholar MUST take advantage of one or more of the following:

- Approved international experiences with CEAT Scholars Programs
- Research experience outside of continental US with a significant global focus
- Course(s) which focus on global issues accompanied by study abroad course <http://abroad.okstate.edu/>
- Engineering Study Abroad Programs <http://ceatde.okstate.edu/2016-schedule-study-abroad>

❑ Service Learning

GCSP Scholars must develop and deepen their social awareness and demonstrate motivation to bring technical expertise to bear on societal problems. Each GCSP Scholar must participate in the leadership of a service learning effort, examples are listed below and in Appendix D:

- Volunteer with an approved service learning program <http://volunteer.okstate.edu/service-learning>
- Earn the CORD (Creating Opportunities for Responsible Development) <http://volunteer.okstate.edu/cord-program>
- Help lead a project with Engineers without Borders at OSU <http://www.ewb-osu.okstate.edu/node/24>

EARLY STUDENT ENGAGEMENT:

To promote early student engagement, all incoming engineering and engineering technology students will be introduced to the principles of the Grand Challenges at the Summer Bridge Program prior to the beginning of classes in the fall and through the required first year engineering course, Introduction to Engineering, taught in the first semester. Recruiting and marketing materials will be distributed in class and the context of the program integrated into class discussions. Students may also incorporate any of these principles in the required classroom group presentation at the end of the semester. Additional information on the GCSP will be disseminated under the College's website <http://ceat.okstate.edu/>

PROGRAM SEQUENCE:

The Grand Challenge Scholars Program at Oklahoma State University allows students to choose the path most desirable to their academic needs. There is no specific sequence for completing the program; however, they will be encouraged to complete components of it before they officially apply for the GCSP designation. A typical model for successfully carrying out all the requirements is shown below:

First Year:

1. Grand Challenges are introduced during the freshman course ENGR 1111: Introduction to Engineering
2. Participate in the Freshman Research Scholars Program
3. Start earning the CORD for service learning at OSU
4. Possibly take appropriate classes in one of the Grand Challenge components.

Second Year:

1. Interested students are encouraged to find a mentor and prepare an application and proposal for a portfolio (see Appendix A for outline).
2. Become active in Engineers without Borders or continue working on CORD
3. Seek an internship or CO-OP rotation.
4. Explore research projects in the Niblack or Wentz Research programs.
5. Enroll in study abroad or
6. Participate in an entrepreneurial project

Third Year:

5. Scholars are encouraged to complete research projects, study abroad assignments, or entrepreneurial experience.
6. Perform second and summer internship rotation.
7. Attend a local or GCSP regional summit.
8. Take appropriate class(s) in one of the Grand Challenge components.

Fourth Year:

9. Complete research project and present findings.
10. Submit final report(s) / Honors thesis.
11. Attend National Summit
12. Prepare and present capstone presentation.
13. Complete appropriate class(s) in one of the Grand Challenge components.

ADMINISTRATION AND ASSESSMENT:

To maintain the high standards expected from a quality program, assessment and success of our Grand Challenge Scholars Program will be the responsibility of everyone involved. To lead this charge, the CEAT Scholars Director will serve as the Director of the GCSP. The Director will participate in the electronic community for the exchange of GCSP best practices, attend workshops and summits, and prepare an annual report of programmatic accomplishments for the GCSP. The Director will be responsible for the training of all mentors in the program requirements and connecting them to the university resources in entrepreneurship, service learning and undergraduate research to assist students in developing portfolios, and previously approved activities for program credit.

The administration and supervision of the program will be performed by an Oversight Committee comprised of faculty members selected from within the College of Engineering, Architecture and Technology. The GCSP Oversight Committee will be responsible for the following:

- Select students and monitor their progress (along with the GCSP Mentor),
- Verify and document the program objectives,
- Approve portfolios that successfully integrate the GCSP Components,
- Compile the names and accomplishments of GCSP Scholars
- Convey all information to the Oversight Committee Chair and GCSP Director as part of the required annual report,
- Assist with longitudinal tracking of GCSP Scholars Program in cooperation with the Grand Challenge Steering Committee and the NAE, and
- Continually improve upon GCSP Scholars Program experiences.

APPENDIX A: GCSP Portfolio Outline

GRAND CHALLENGE SCHOLARS PROGRAM PORFOLIO OUTLINE			
GCSP Student Name: _____		Signature: _____	
CWID: _____ Major: _____		Date: _____	
GC Focus Area: _____		GCSP Mentor: _____	
Required Element	Description of Breadth Component	Description of Depth Component	Mentor initials
Research	Required	Option 1 (Choose 2 of the 4 options)	
Interdisciplinary Curriculum	Required	Required	
Entrepreneurship	Required	Option 2 Choose 2 of the 4 options)	
Global Awareness	Required	Option 3 (Choose 2 of the 4 options)	
Service Learning	Required	Option 4 (Choose 2 of the 4 options)	
Capstone Project or Honors Thesis	Required		
Plan Approval – GCSP Mentor: _____ Date: _____		GCSP Director on behalf of the Oversight Committee: _____ Date: _____	

GCSP Capstone:

Program Components

The importance of a student's experience in the Grand Challenge Scholars Program is based upon the completion of the 5 curricular components, tied either specifically or thematically to Grand Challenge or select UN Sustainable Development Goal focus topics.

Scholars are required to undertake one (1) element in each of the following components:

1. Research,
2. Interdisciplinary Curriculum,
3. Entrepreneurship,
4. Global Awareness, and
5. Service Learning.

In addition, GCSP students will be expected to gain depth in the GCSP by completing two (2) or more elements in 3 of the components, including Interdisciplinary Curriculum, and a choice of remaining component. While not all inclusive, the following elements are typical elements in the GCSP:

Research Elements

1. Approved team (or individual) research or senior design project related to GCSP topic
2. Research Experience for Undergraduates (REU) related to GCSP topic
3. Research work experience for a summer or semester (e.g., Research Assistant)
4. University Honors Program - Undergraduate Research Symposium
5. Approved interdisciplinary research programs related to GCSP topic

Interdisciplinary Curriculum Elements

1. Research experience with an interdisciplinary focus
2. Course(s) relating to a Grand Challenge theme (e.g., non-engineering)
3. GCSP focused general education electives
4. Approved interdisciplinary degree, minor, or honors programs
5. Internship with an interdisciplinary focus

Entrepreneurship Elements

1. Riata Entrepreneurs Program
2. Entrepreneurship Internship
3. Entrepreneurial Research Program
4. Entrepreneurial Minor (2 Courses)

Global Awareness Elements

1. Approved international experiences
2. Co-op or internship with a significant global focus
3. Research experience with a significant global focus
4. Course(s) which focus on global issues

Service Learning Elements

1. Volunteer experience with a significant service-learning focus

2. Research experience with a significant community focus
3. Course(s) which focus on service and/or community-related issues
4. Center for Student Leadership, Ethics, and Public Service; SORC, etc.

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APPENDIX B: Accepted Courses

Interdisciplinary Curriculum

Requirements can be fulfilled by taking one or more of these courses. Courses not listed may be petitioned for approval by the student's GCSP mentor and/or added to the list.

AGLE 3403	Facilitating Social and Technological Change in Agriculture
AGLE 3803	(I) Global Leadership in Agriculture
AMIS 4013	(D) American Indian Sovereignty
ARCH 2003	(H,I) Architecture and Society.
BIOC 2200	Medicine and Molecules.
BOT 3253	(N) Environment and Society
BADM 3101	(D) Diversity Impacts on Business
ECON 3033	Economics of Entrepreneurship and Innovation
ECON 3903	Economics of the Environment
ECON 3903	Energy Economics: Traditional and Renewable Energy Markets.
ECON 4643	(I,S) International Economic Development.
EEE 1010	Creativity, Innovation and Entrepreneurship
EEE 3033	(D) Women and Minority Entrepreneurship
EEE 3403	Social Entrepreneurship
EEE 3713	(D) Native American Entrepreneurship
ENVR 4512	Environmental Impact Analysis
FPST 2344	Elements of Industrial Hygiene.
GEOG 3173	(S) Cultural Geography
HONR 2063	(H) Ethical Issues Across Cultural Perspectives
HONR 3023	(H,I) Contemporary Cultures of the Western World
HONR 3033	(I,S) Contemporary Cultures of the Non-Western World
MGMT 4403	Environmental Sustainability for Business
MGMT 4463	Industrial Ecology for Business
NREM 2013	Ecology of Natural Resources
NSCI 2114	(N) Principles of Human Nutrition
NSCI 3543	(I,S) Food and the Human Environment
PHIL 3413	(H) Ethical Theory
PHIL 3743	(H) Patterns in Science: Historical & Value Dimensions of Western Science
PHIL 3833	(H) Biomedical Ethics
SOC 4433	(S) Environmental Sociology
SOC 4463	Technology and Society
SOC 4533	World Population Problems
SC 3383	Strategic Communications Management and Strategies

APPENDIX C: Global Awareness and Entrepreneurship Options

In addition to participating in a study abroad program where the Grand Challenges element makes up 30% of the graded course, the global awareness requirements can be fulfilled by taking one or more of these courses. Courses not listed must be approved by the student's GCSP mentor and the program oversight committee.

ENGR 4060 Study Abroad: Brazil
ENGR 4060 Study Abroad: Germany/N.Europe
ENGR 4060 Study Abroad: India
ENGR 4060 Study Abroad: Japan
ENGR 4060 Study Abroad: China/Tibet
ENGR 4060 Study Abroad: Honduras
ENGR 4060 Study Abroad: Engineers without Borders
ENGR 4060 Study Abroad: CEAT Scholars
ENGR 4060 Study Abroad: Rome/Italy

Requirements for the Entrepreneurship component can be fulfilled by taking one or more of the courses listed below. Courses not listed must be approved by the student's GCSP mentor and the program oversight committee

EEE 3023 Entrepreneurial Thinking and Behavior
EEE 3033 Women & Minority Entrepreneurship
EEE 3213 Entrepreneurship & the Arts
EEE 3263 Entrepreneurial Marketing
EEE 3333 Launching a Business: The First 100 Days
EEE 3403 Social Entrepreneurship 1
EEE 3713 Native American Entrepreneurship
EEE 4263 Corporate Entrepreneurship
EEE 4483 Entrepreneurship & New Technology
EEE 4513 Strategic and Entrepreneurial Management
EEE 4653 Venture Capital
EEE 4703 Project Management for Entrepreneurs
EEE 4803 Operating an Entrepreneurial Firm

APPENDIX D: Service Learning Organizations

Students are required to complete the service learning component by choosing to volunteer with organizations that benefit the community, society, and the world. Below are a few such organizations at Oklahoma State University. GCSP scholars are encouraged to visit the [OSU Service Learning Center](#) in 211 Student Union. A student may choose to complete an individual community project with an organization but must have the approval of their GCSP Mentor prior to initiating the work.

Amnesty International

An organization to advocate the release of prisoners of conscience.

Circle K International

An organization to provide leadership training through campus and community involvement.

Collegiate Students Fighting Hunger

Our purpose is to establish an on campus food pantry, create volunteer opportunities, and educate people about hunger.

CowboyThon (CT)

CowboyThon is the campus' largest philanthropic effort. It is a dance marathon that benefits the Oklahoma Children's Hospital.

Cowboy Waterworks (CW)

Cowboy Waterworks promotes public awareness and education of the issues of water quality and water power

Engineers without Borders (EWB-OSU)

EWB-OSU gives students the opportunity to travel abroad and use their skills to serve those in need of clean water, sanitation, and energy

Habitat for Humanity (HH)

Habitat for Humanity International at OSU strives to eliminate poverty housing and homelessness from the face of the earth by building adequate and basic housing. Our chapter at Oklahoma State is devoted to working towards that goal.

Wings of Hope Crisis Center

Wings of Hope Family Crisis Services provides comprehensive and confidential services to individuals and families experiencing domestic violence, sexual assault, stalking, and child abuse