

Program

National Academy of Engineering Grand Challenges Scholars Program

Applicant

State University of New York (SUNY)
College of Environmental Science and Forestry (ESF)
www.esf.edu

Contact Information

Dr. Theodore Endreny, P.H., P.E.
Professor and Chair in Department of Environmental Resources Engineering (ERE)
402 Baker Labs, 1 Forestry Drive
Syracuse, NY 13210
315-470-6565, te@esf.edu

Dr. Gary Scott
Director, Division of Engineering
Professor and Chair in Department of Paper and Bioprocess Engineering (PBE)
205 Walters Hall, 1 Forestry Drive
Syracuse, NY 13210
315-470-6501, gscott@esf.edu

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1. Vision and Goal for ESF Grand Challenge Scholars Program

SUNY-ESF has a goal and a vision to train students to address the grand challenges and thereby use their engineering to improve the world. We are entering the National Academy of Engineering (NAE) Grand Challenges Scholars Program (GCSP) to use the 5 competencies to realize this engineering training. The 5 competencies are: 1) research and creativity; 2) multidisciplinary; 3) business / entrepreneurship; 4) multicultural; and 5) social consciousness. These competencies will help students achieve engineering that involves the planning, design, construction, and operation of useful products, processes, or systems to improve the economic, environmental, and social conditions around the world.

ESF's vision to complete the NAE GCSP fits within ESF's educational mission, to advance knowledge and skills to promote the stewardship of both the natural and designed environments. Training of engineers in the NAE GCSP embodies the ESF slogan, "Improve your world".

ESF has engineering programs that focus on environmental resources. These ESF programs directly and indirectly support many of the NAE Grand Challenges. Some examples include: 1) make solar energy economical; 2) develop carbon sequestration methods; 3) manage the nitrogen cycle; 4) provide access to clean water; 5) restore and improve urban infrastructure; 6) advance personalize learning; and 7) engineer the tools of scientific discovery.

ESF engineering students are eager to join and participate in the GCSP for many reasons, including for networking. The ESF community values GCSP's nationwide network and the opportunities it provides our students to engage in GCSP and other NAE workshops, programs, and discussions through face-to-face and online forums. Establishing an ESF GCSP will allow ESF engineering students to benefit from this GCSP networking, and advance the GCSP objective of growing this network and educating future leaders of the NAE Grand Challenges.

2. Selection of ESF GCSP Scholars

The ESF GCSP will coordinate recruitment of a diverse cohort of engineering students as scholars into the program. Selection of ESF GCSP scholars will be coordinated by the ESF GCSP management team and follow the ESF GCSP operational timeline. The ESF GCSP scholar selection criteria, management team structure, and operational timeline are as follows:

ESF GCSP management team structure and budget:

The ESF GCSP management structure has the following organizational categories, with specific names in each category changing with changes in personnel:

1. ESF Provost;
2. ESF Director, Division of Engineering;
3. ESF GCSP Director;
4. ESF GCSP Steering Committee;

5. GCSP Student Mentors; and
6. GCSP Scholars.

The ESF Provost supervises the ESF Director for the Division of Engineering and the ESF GCSP Director. The ESF Director for the Division of Engineering at ESF is comparable to the Dean of Engineering at other academic institutions.

The ESF GCSP Director will provide to the Provost and Director of Engineering an Annual Report on the ESF GCSP, which would include a summary of annual events and meetings, updated procedures and forms, names of students actively enrolled, names of students who received ESF GCSP scholar recognition that year, documentation of assessment activities.

The ESF GCSP Steering Committee will contain 3 members, who are the ESF GCSP Director, an ESF faculty member separate from the GCSP Director, and a member on the ESF Alumni Group Advisory Council.

The GCSP Student Mentors is a group of upper-level students who are also GCSP Scholars or graduates and can provide guidance to less experienced GCSP Scholars.

Budget: The SUNY ESF ERE Department will maintain a budget of \$25 per scholar per year to pay for operational costs, including issuance of certificates, dissemination of materials, and food and drink at GCSP meetings and ceremonies. The ESF GCSP Director will utilize ERE secretarial and work-study resources to help coordinate the management.

ESF GCSP scholar selection criteria:

The ESF GCSP will provide a streamlined application form presenting the selection criteria in order to facilitate student completion of the application. The criteria are:

1. Engineering student in good standing as evidenced by their enrollment in an engineering program and maintaining a GPA of 2.7 or higher at ESF;
2. Statement of commitment to apply or advance engineering knowledge to address problems with environmental, social, economic dimensions, presented with specific sections:
 - a. prospective – how the student imagines they might fulfill this commitment after college,
 - b. objective – how the student has planned to advance this commitment during current academic year, and
 - c. retrospective – how the student demonstrated this commitment in an activity or insight during the past year;
3. Curricular Plan submitted by the student, indicating how they intend to complete the GCSP, with specific sections:
 - a. research/creative – identifying the NAE Grand Challenge category and specific topic they will most likely address, or have addressed, and

- options for mentoring [This may advance knowledge and provide solutions for 1 or more of the grand challenge areas];
- b. multidisciplinary – identifying the multidisciplinary experience they will engage, or have engaged, and when [This may combine engineering with other disciplines such as policy, business, law, ethics, human behavior, risk, medicine, environment, and sustainability];
 - c. business/entrepreneurship – identifying the entrepreneurship or business experience they will engage, or have engaged, and when [This may prepare students to bring inventions from idea to reality and provides global solutions];
 - d. multicultural – identifying the multicultural experience they will engage, or engaged, and when, [This may develop a global perspective for the student to understand the need and constraints on challenges]; and
 - e. social consciousness – identifying the social consciousness activity or activities they will engage , or have engaged, and when, [This may develop the social consciousness of the student and motivate their engineering training to be of use to society].

ESF GCSP Operational Timeline:

The ESF GCSP operational timeline notes management responsibility and has the following flow:

1. Coordinate ESF GCSP Informational Meetings and Recruitment Sessions & Distribute Applications
 - a. Purpose –
 - i. to recruit a diverse population of new students from the freshman or other class years to consider joining the ESF GCSP and distribute applications;
 - ii. to provide an update to all previously active ESF GCSP scholars who have not graduated of activities planned for the academic year and explain these students need to re-apply to demonstrate they are still committed to the program, still meet the program criteria, and are progressing toward completion of the ESF GCSP curriculum;
 - iii. to announce the deadline for submitting applications.
 - b. Forum – i) to address questions from students and help students complete the application ; ii) recruitment sessions coordinated by GCSP Director and GCSP Student Mentors; and announced via the ESF student email, hallway monitors, posters in open spaces, and online media
 - c. Deadline – throughout September
 - d. Responsible – ESF GCSP Director
2. Collection of ESF GCSP scholar applications
 - a. Purpose –
 - i. to collect applications from students applying for first time into ESF GCSP, where the application is used to determine if students meet the criteria;

SUNY ESF GCSP Application

- ii. to collect applications from students who were ESF GCSP scholars last academic year, where the newly submitted application is used to determine if students continue to meet the criteria and have demonstrated progress toward achieving the ESF GCSP curriculum.
 - b. Forum – electronic submission of the applications as PDFs
 - c. Deadline – October
 - d. Responsible – ESF GCSP Director
 - 3. Review and Interview ESF GCSP scholar applicants
 - a. Purpose –
 - i. to determine which ESF GCSP new applicants meet the criteria and which previously active ESF GCSP scholars continue to meet the criteria and have demonstrated progress toward achieving the ESF GCSP curriculum;
 - ii. to reject ESF GCSP new and returning applicants who did not meet or demonstrate they met the criteria; former GCSP scholars having difficulty completing the program can petition the GCSP Steering Committee for additional time, and are permitted to take a year off from the program;
 - iii. to conduct a brief interview (<30 min) with the ESF GCSP applicants who met the criteria to allow for questions from the student to be addressed if they were not covered during the recruitment sessions, or ask the student questions that arose when reading the application.
 - b. Forum – single or multiple sessions of application reading and scoring to identify the potential cohort, interviews would follow over one or two days
 - c. Deadline – October to November
 - d. Responsible – ESF GCSP Steering Committee
 - 4. Notify new GCSP Student members
 - a. Purpose –
 - i. send formal acceptance letter to applicant congratulating them on becoming an ESF GCSP scholar or returning as an ESF GCSP scholar;
 - ii. explain to ESF GCSP scholars that they can use the GCSP Student Mentors or GCSP Director to address questions on how to make progress in completing their ESF GCSP curriculum.
 - b. Forum – letter sent to students
 - c. Deadline – October to November
 - d. Responsible – ESF GCSP Director
 - 5. ESF GCSP Scholar Meetings and Updates
 - a. Purpose –
 - i. optional meetings initiated by 1 or more ESF GCSP scholars to discuss issues relating to their completion of the ESF GCSP curriculum

- ii. required meetings with ESF GCSP scholars that have completed GCSP requirements to document their completion of requirements and discuss their experiences,
- b. Deadline – ongoing
- c. Responsible – ESF GCSP Director and Student Mentors

3. GCSP Competencies Components

The 5 competencies ESF GCSP scholars complete have a brief description, a path toward completion, and a set of performance criteria to assess satisfactory completion.

1. Research | Creative Experience:

This competency provides GCSP scholars with substantial engineering research or design exercises to address a NAE Grand Challenge, listed here: 14 Challenges. The world's brightest thinkers identified these 14 Grand Challenges for Engineering in the 21st century, and they fit into four cross-cutting themes: Sustainability, Health, Security, and Joy of Living.

The path to complete this competency involves completing a research experience. The student may use an honor thesis, ERE 498 course, an NSF REU, or an equivalent research experience to conduct research. The research conducted by the student will be planned in a proposal, and described in a final report. An equivalent research experience could involve work completed under the supervision of a student's ESF Honors Program mentor.

Deliverable: A proposal should be submitted as a DOCX and PDF file, named GCSP-pr-[YYYYMMDD-student last name], AND a report submitted as a DOCX and PDF file, named GCSP-re-[YYYYMMDD-student last name].

The performance criteria to complete this competency are to submit a 2 to 5 page proposal at the start of the project, and a 5 to 15 page report at the completion. These document page limits do not include a cover page, references, figures and tables, or appendices. The proposal should contain the following sub-sections: introduction, project or research objectives and questions, review of prior research on topic, methodology, expected results, schedule, budget, and project personnel including those providing access and guidance with methods. The final report should contain the following sub-sections: introduction and motivation, project or research objectives and questions, review of prior research on topic, methodology, results, discussion of how the findings addressed the NAE Grand Challenge and have broader impacts for environmental and social and/or global sectors, conclusion. The quality of the work will be judged by its grammar, organization, appropriateness, accuracy, thoroughness, and documentation. Research reports already completed by the student can be used and would be submitted to the ESF GCSP Steering Committee for review and acceptance.

2. Multidisciplinary | Engineering+:

This competency combines engineering and non-engineering perspectives on the NAE Grand Challenge.

The path to complete this competency involves completing an interdisciplinary curricular or non-curricular experience AND submitting a blog post to the web by ESF GCSP. The course ERE 275 Ecological Engineering satisfies this competency by thematically combining engineering with social science, environmental science, or economics to discuss how engineering designs affect the three components of sustainability. Alternative courses can be petitioned to satisfy this ESF GCSP competency.

Deliverable: A blog required of ESF GCSP scholars will present a systems perspective of how an engineering plan, design, or project is connected to social, economic, and environmental sectors, providing at least 4 journal references to support their argument. The blog for this competency should have a first line that reads, "ESF Grand Challenge Scholars Program scholar, [student first and last name], explains how sustainable engineering design requires a systems perspective, where fields such as economics, ecology, and sociology inform engineering". The blog should be submitted as a DOCX file, named GCSP-epblog-[YYYYMMDD-student last name], and will be published at WordPress under the ERE blog, EREENGINEERING.

The performance criteria to complete this competency is a B or better in the course, and a satisfactory blog; satisfactory is based on grammar, organization, appropriateness, accuracy, thoroughness, and documentation.

3. Business | Entrepreneurship:

This competency trains GCSP scholars to bring inventions from idea to reality and provide global solutions to the NAE Grand Challenge.

The path to complete this competency involves completing formal or informal business or entrepreneurship training, AND submitting a business plan AND short marketing video to the ESF GCSP. The training will likely instruct the scholar on the challenges and goals of creating a start-up venture, training students to recognize trends in the marketplace, identify where commercial opportunities can be created, and analyze the feasibility and potential to create a sustainable venture.

Deliverable: A business plan should be submitted as a DOCX and PDF file and the video as a MPG or equivalent file, with the file named GCSP-e-[YYYYMMDD-student last name], to be uploaded to an ERE website dedicated to ESF GCSP work (www.esf.edu/ere/gcsp).

The performance criteria to complete this competency is a satisfactory business plan and marketing video; satisfactory is based on the report's and video's grammar, organization, appropriateness to the NAE GCSP topic, accuracy, thoroughness, and

for the report, documentation explaining key start-up issues unique to science and technology firms.

4. Multicultural / Global Dimension:

This competency exposes GCSP scholars to an international experience that demonstrates the global need to address NAE Grand Challenge.

The path to complete this competency involves completing a global dimension opportunity AND submitting a detailed report in the form of a blog post to ESF GCSP on the global dimension of the NAE Grand Challenges. The experience used by the student should consider the geography of the problem, case-studies of failed or successful solutions, and identify how the NAE Grand Challenges have a global reach.

Deliverable: A detailed blog should have a first line that reads, "ESF Grand Challenge Scholars Program scholar, [student first and last name], explains how a global perspective helps advance engineering solutions to pressing problems affecting sustainability". The blog should be submitted as a DOCX file or equivalent, named GCSP-g-[YYYYMMDD-student last name], and will be published at WordPress under the ERE blog, EREENGINEERING.

The performance criteria to complete this competency is a satisfactory detailed blog; satisfactory is based on the blog's grammar, organization, appropriateness, accuracy, thoroughness, and documentation. Appropriateness is demonstrated by the ESF GCSP scholar explaining why a global perspective is beneficial in advancing solutions to the NAE Grand Challenges.

5. Social Consciousness / Service Learning:

This competency develops for the ESF GCSP scholar the social consciousness to understand that by working with communities we are better able to address the NAE Grand Challenges.

The path to complete this competency involves completing the service learning opportunity AND submitting a detailed blog report on the activity and how service learning can address the NAE Grand Challenges. The course or non-course activity should be registered with the SUNY ESF Student Affairs Office in their Service Learning database, so that completion of the service learning hours are documented by the course professor or program coordinator. The service learning experience should engage a project identified as important by community stakeholders, such as townships, community groups, or businesses, and the project should be addressed within a one year experience in problem analysis, teamwork, project management, engineering ethics, professional communication and related aspects. The course ERE 489 ERE Planning and Design satisfies the service learning opportunity, and equivalent experiences are accepted.

Deliverable: A detailed blog should have a first line that reads, "ESF Grand Challenge Scholars Program scholar, [student first and last name], explains how a

service learning develops a social consciousness critical to developing appropriate engineering designs". The blog should be submitted as a DOCX file or equivalent, named GCSP-sl-[YYYYMMDD-student last name], and will be published at WordPress under the ERE blog, EREENGINEERING.

The performance criteria to complete this competency is a satisfactory blog; satisfactory is based on the blog's grammar, organization, appropriateness, accuracy, thoroughness, and documentation. Appropriateness is demonstrated through a report that explains how the service learning experience integrated engineering coursework with a community focused problem or idea and engaged a collaborative engineering design process to solve interdisciplinary problem.

4. Assessment and Tracking

ESF GCSP Assessment Sheet

The ESF GCSP uses performance criteria for each of the five curricular areas to assess student progress toward completing the GCSP. A digital **ESF GCSP Assessment Sheet** will be created for each ESF GCSP scholar when they first enter the ESF GCSP. The digital ESF GCSP Assessment Sheet facilitates recording and tracking scholar progress. Each ESF GCSP scholar will have their ESF GCSP Assessment Sheet maintained on their digital and secure folder within ESF Registrar's website and be accessible for editing by the ESF GCSP Director and for viewing by the student. The sheet will record the date the student was first admitted to the ESF GCSP and will have a list of the five curricular areas that require completion, with boxes to enter the date they were completed, and to confirm the documentation was loaded to the ESF GCSP website (likely URL www.esf.edu/gcsp).

Performance criteria

Performance criteria are used to determine whether the curricular components were satisfactorily completed. These performance criteria are listed below each of the curricular areas listed in section 3 Curricular Components. Performance on each curricular component will be noted as satisfactory or unsatisfactory on the ESF GCSP Assessment Sheet. Unsatisfactory work will be returned to the ESF GCSP Scholar for revision and resubmittal. If the first submission is not satisfactory the ESF GCSP Director will recommend the ESF GCSP scholar meet with ESF GCSP Student Mentors and other ESF GCSP personnel to receive guidance on bringing their product to satisfactory. After 2 revisions (3rd submitted version) if the product is not converging toward satisfactory condition, the ESF GCSP Director will recommend a meeting with the scholar and ESF GCSP Steering Committee to decide if the student should be provided additional opportunities for revision or begin anew with the curricular component.

Oversight, reporting, and award ceremony

Completion of all ESF GCSP requirements will be noted by the ESF GCSP Director checking a completion box on the ESF GCSP Assessment Sheet. Clicking this box will trigger an email sent to the ESF GCSP Steering Committee inviting them to review the sheet and confirm the completion. The ESF GCSP Steering Committee members can confirm completion by re-inspecting student work on the ESF GCSP website and ERENGINEERING blog, as well as meet with the ESF GCSP Director to confirm student performance on the curricular components. Once the ESF GCSP Steering Committee has signed off on the ESF GCSP Assessment Sheet for the scholar, an email is sent to the GCSP National Steering Committee certifying the ESF GCSP scholar has completed the ESF GCSP requirements. With permission of the GCSP National Steering Committee, an email will be sent by ESF GCSP Director to the ESF GCSP scholar confirming they have completed the program and a certificate will be awarded. A formal award ceremony will be held during convocation each December and May on the ESF campus as part of the Department of ERE graduation ceremony, presenting successful scholars their ESF GCSP certificates before the audience of peers, students, faculty, staff, and parents.

The ESF GCSP Annual Report will be submitted by the ESF GCSP Director to the GCSP National Steering Committee, and it will document annual activities and graduated ESF GCSP scholars.

Table 1. Illustrative activities to complete the 5 NAE GCSP competencies

Curricular Component	Course Activity	Non-Course Activity
1. Research / Creative Activity (choose a course and/or non-course activity)	Choose 1 of the following: a) ERE 498, Research Problems in Environmental Resources Engineering b) ERE 597, Research Methods for ERE	Choose 1 of the following: a) Equivalent research experience (e.g., Honors Program) b) Participate in National Science Foundation Research Experience for Undergraduates c) Participate in the research and development of an Engineers Without Borders project d) Participate in a Fink or Rosen Fellowship sponsored research project e) Or equivalent experience
Curricular Component	Course Activity	Non-Course Activity
2. Multidisciplinary (choose a course or non-course activity)	Choose 1 of the following: a) ERE 275 Ecological Engineering b) ERE 311 Ecological Engineering in the Tropics c) ERE 412 River Form and Process d) ERE 570 Hydrology in a Changing Climate	Choose 1 of the following: Combine engineering with: e) policy, f) business, g) law, h) ethics, i) human behavior, j) risk, k) medicine, l) environment, or m) sustainability
Curricular Component	Course Activity	Non-Course Activity
3. Business / Entrepreneurship (choose a course and/or non-course activity)	Choose 1 of the following: a) ERE 519 Green Entrepreneurship b) Other equivalent course	Choose 1 of the following: a) Develop a business plan through the Syracuse University Department of Entrepreneurship and Emerging Enterprises

		<ul style="list-style-type: none"> b) Develop a business plan through the Green Campus Initiative's Student Sustainability Fund c) Develop a business plan through the Yum! Sustainability Challenge d) Develop a business plan through the D-Prize e) Develop a business plan through the GrabCAD challenges f) Or equivalent experience
Curricular Component	Course Activity	Non-Course Activity
4. Multicultural / Global Dimension	Choose 1 of the following: <ul style="list-style-type: none"> a) ERE 512 Humanitarian Engineering for Development Workers b) ERE 405 Sustainable Engineering c) ERE 311 Ecological Engineering in the Tropics d) FOR 523 Tropical Ecology e) GEO 374 Environment and Development in the Global South 	Choose 1 of the following: <ul style="list-style-type: none"> a) Participate in and report on a club (e.g. EWB) or conference pertaining to international development b) Participate in and report on a study abroad program c) Participate in and report on Operation Wallacea d) Participate in and report on the Engineering for Change's website e) Or equivalent experience
Curricular Component	Course Activity	Non-Course Activity
5. Social Consciousness	Choose 1 of the following <ul style="list-style-type: none"> a) ERE 489, Engineering Planning and Design b) An equivalent course required of ESF students regarding service learning 	Choose 1 of the following: <ul style="list-style-type: none"> a) Participate in and report on the service learning activities in the annual EPA Campus RainWorks Challenge Team b) Participate in and

	c) Or equivalent course	report on the service learning activities in the ERE, NYWEA, and/or AWMA clubs on campus c) Participate in and report on the service learning activities in the local Alpha Phi Omega or Alpha Xi Sigma service and honor fraternities d) Or equivalent experience
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