

Proposal to establish a  
Grand Challenge Scholars Program at  
**Quinnipiac University**

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## **Introduction**

We are pleased to submit this proposal to establish a Grand Challenge Scholars Program (GCSP) at Quinnipiac University. In accordance with the National Academy of Engineers (NAE) GCSP “Operational Document for Proposing a GCSP at Your School”, this document describes Quinnipiac University’s vision 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**

We believe that the set of Quinnipiac engineering students who become GC Scholars will have an additional edge to their education. As professionals upon entering the workforce, they will be better prepared, as a result of the competencies they gain within the GCSP. These students will have more to offer during the hiring process as well as starting a new position. They will be more desirable by the employers, due to their broader perspective, business sense, and teamwork.

The educational model at Quinnipiac in many ways is very aligned closely with the aims of GCSP. As such, this Section discusses the Quinnipiac educational framework first, before discussing the GCSP within the School of Engineering.

Established in 1929, Quinnipiac is a private, coeducational, nonsectarian institution with strong professional programs, including the recently established School of Engineering (SoEng). The School offers four undergraduate-only engineering programs in Civil, Industrial, Mechanical, and Software, as well as Computer Science. An education at Quinnipiac embodies the University's commitment to three core values: high-quality academic programs, a student-oriented environment and a strong sense of community. The university enrolls 7,000 full-time undergraduate and 3,000 graduate and part-time students in 110 degree programs and prepares undergraduate and graduate students for achievement and leadership in its Schools of Business, Communications, Education, Engineering, Health Sciences, Law, Medicine, Nursing, and College of Arts and Sciences.

Quinnipiac University educates students to be valued and contributing members of their communities through a vital, challenging and purposeful educational program. Students engage real-world issues through practice and the consideration of different perspectives.

To fulfill its educational mission, Quinnipiac:

- offers degree programs centered on effective practice that are strengthened by the integration of a liberal education;
- cultivates critical thinking, intellectual integrity, curiosity and creativity in the pursuit of knowledge;
- provides a variety of learning and service experiences to facilitate student achievement;
- maintains a strong commitment to a diverse and inclusive student body, faculty and staff;
- fosters an understanding of and respect for the multiplicity of human perspectives and belief systems;
- supports faculty teacher-scholars who are effective teachers and who engage in scholarship.

A Quinnipiac education fosters in-depth learning, the gaining of disciplinary expertise (the major), and promotes an interdisciplinary understanding of the expertise in local and global contexts (the University Curriculum). In addition, a QU education inspires students to learn how to work independently, both in and outside the classroom, to gain a closer and more complex sense of themselves as citizens, intellectuals and human beings. Through the University Curriculum, intentional learning is fostered by studying human cultures, artistic and literary expressions, the physical and natural worlds, and the forces that have shaped and continue to shape our world. Students develop a flexible and open mind, the capacity to learn from others, effective communication skills and the ability to influence potential solutions to global problems. Students demonstrate their abilities through classroom and civic engagement, in both their local and global communities. A student's education at Quinnipiac University is a single, reciprocal process with specialized education in the major integrated with general education, with each providing dimension to the other. In the way that the major leads a student to deep, disciplinary knowledge, general education leads a student to broad knowledge gained from multiple perspectives and in concert, they support the students' achievement as measured by the Essential Learning Outcomes. A Quinnipiac University graduate is a well-rounded individual who demonstrates knowledge of science, cultures, numeracy, the arts, history and society as well as an ability to apply learning to complex problems and challenges. The requirements of the University Curriculum assure that all students receive a broad education that exposes them to different perspectives and ways of knowing, producing lifelong learners who can, upon graduation, become leaders in their professions, in the communities where they live, and in their role as informed citizens.

### **Current Educational Framework Being a Natural Fit with GCSP**

Upon entering Quinnipiac, freshman students in all majors take a 3-credit First-Year Seminar course (FYS 101) and are introduced to inquiry-based learning. The students learn about important concepts such as issue mapping as they consider complex problems that cannot be solved by one person or one profession. They learn to move away from a prescribed education and to take ownership of their education by focusing on academic and co-curricular activities that matter to them. They develop a Guiding Question, an overarching, complex question that provides a context for the student's inquiry-based education. Ideally, a Guiding Question is one that can be pursued throughout the student's undergraduate education, but never answered, one that cannot be solved by one person or one profession. Keeping this Guiding Question in mind, the students develop their roadmap and milestones which entail the University Curriculum (UC) courses, courses in their majors, minors, Study Abroad and service trip experiences, among other co-curricular activities. All students are expected to take a certain number of UC courses prior to graduation.

This Quinnipiac-wide model is a natural fit with the GCSP framework. In parallel with the FYS 101 course, all freshman engineering students take The World of an Engineer (ENR 110) in their first semester upon entering the university. This course has no pre-requisite and in its previous five offerings, there have always been several students from outside the SoEng. It is beneficial to have non-engineering students take the ENR 110 course along with the engineering students as they start to examine the grand challenges in this course. While the first part of the course introduces the students to the four disciplines of engineering offered at Quinnipiac, the latter part

focuses on the grand challenges. Student teams, made up of at least two disciplines of engineering, select a specific grand challenge, justify their selection, and conduct introductory research on the importance of the particular grand challenge, as well as the various factors that play a role. The assignment leading to the final presentation is provided in Appendix 1. For each section of 20 students in a class, two Peer Catalysts facilitate the discussions, alongside the instructor. Peer Catalysts are juniors and seniors in non-engineering fields and their primary task is to ensure the students consider non-technical perspectives, such as economical, political, and sociological, in their discussions. A proposal was successfully submitted to grant a UC designation for ENR 110. As a result, starting from August 2018, more students from outside the SoEng will take this course to combine their interest in engineering with satisfying one of their UC course requirements, contributing to a multidisciplinary education for all students.

All the aforementioned activities in The World of an Engineer course occur in parallel with the mandatory First-year Seminar course, where all students are required to develop a Guiding Question. Development of the Guiding Question in turn influences the students in their selection of University Curriculum. Rather than taking a certain number of humanities, social science, and fine arts courses because they are mandatory, the students take courses that contribute to their knowledge as they pursue knowledge to help inform them about their Guiding Question. For example, a Civil Engineering student whose Guiding Question is “how can we provide access to clean water in east Africa?” may choose to take “Microeconomics” and “International Business Environment” as her two Social Science requirements, “Global Issues: Introduction to Cultural Anthropology” and “Anthropology of Health and Medicine” as her two Humanities requirements, and “Basic Visual Design” as her Fine Arts requirement. It should be noted that this is just an example; students will embark on their own journey and choose their own courses. This is the essence of inquiry-based learning and empowering students to take ownership of their education. However, GCSP students’ responsibility is to justify the alignment of their chosen set of UC courses with their Guiding Question.

Our SoEng students will continue to interact with non-SoEng students throughout their undergraduate studies. This experience is culminated by a UC capstone course that students take in their senior year. As of Spring 2019, SoEng will offer five sections of the Integrative Capstone course, ENR 410, open to the entire Quinnipiac community. Each one of these capstone courses is centered on an aspect of a grand challenge. Faculty from SoEng have already participated in a Systematic Design of Instruction in June 2017 to start developing the capstone courses. One syllabus is provided as reference (Appendix 2).

As can be seen from the aforementioned framework in place, engineering students work side-by-side with non-SoEng students throughout the undergraduate education, providing an opportunity for multidisciplinary collaborations. Much of this is done within the context of the grand challenges.

### **Program Elements Covering GCSP Competencies**

This section describes how the GCSP at Quinnipiac University will require all GC scholars to fulfill the five competencies of the program, as mandated by the NAE. Each GC Scholar will have a GCSP portfolio and as they advance within each competency area, they submit the appropriate document to this portfolio. GC Scholars will be aware that their activities within the

five competency areas are unified and should all contribute towards their particular Grand Challenge of choice. This portfolio is reviewed and approved by the GCSP committee and Director prior to the completion of the GC Scholar's program.

Acceptable activities for completing these components are summarized in Appendix 3.

### **Hands-on Project or Research Experience**

To satisfy the "research/creative project experience", all GC Scholars will be required to execute a hands-on or research project related to a Grand Challenge. Typically, this project will be defined and executed within a required course, ENR 410, Integrative Capstone. In addition, each GC Scholar will be required to present his or her research through a poster presentation during the School of Engineering Projects Day. Each GC Scholar will include this poster on his/her GCSP portfolio. ENR 410 is considered a UC course and as such, it requires the students to write a reflection to connect the experiences gained in ENR 410 with their Guiding Question. In the sample syllabus provided in Appendix 2, this reflection can be seen as a grading component. GCSP students will upload their reflection onto their GCSP ePortfolio.

Implementing this component of the GCSP should not be difficult because it will be integrated within a required course. This 3-credit, integrative capstone course is required for all QU students, and the engineering students have the opportunity to take an integrative capstone course focused on one of the Grand Challenges.

Each academic year, there will be multiple sections of the Integrative Capstone course offered. However, since all Grand challenges will not be covered in an Integrative Capstone course, other options currently at QU will also satisfy the research experience requirement. These include SoEng summer research programs as well as Independent Study courses with faculty. These can have a special emphasis on the Grand Challenges and provide and promote additional research. It should be noted that Independent Study courses are for three credits and have the same rigor as a regular 3-credit course. The summer research program spans over 10 weeks and provides a rigorous experience, with clear deliverables.

Quinnipiac SoEng already has a track record as in the past, we have had students do one-on-one Independent Study courses with a faculty focusing on enhancing virtual reality. One example was a project that used an oculus headset and an Xbox Kinect to train proper patient lifting techniques to clinicians. Another project investigated the usage of a haptic glove to train clinicians on detecting a torn ACL.

If a GCSP student chooses to use a research project or an Independent Study, rather than the Integrative Capstone course, to fulfill the Research Experience component, they will write a reflection and submit it to their GCSP ePortfolio upon the completion of the project. In this reflection, the student will align his/her experience in the research project or Independent Study with their pursuit of their chosen grand challenge.

### **Multidisciplinary Curriculum**

The Quinnipiac education is interdisciplinary by design. A student's education at Quinnipiac University is a single, reciprocal process with specialized education in the major integrated with

general education, also referred to as the University Curriculum, UC, with each providing dimension to the other.

All Quinnipiac students are required to take 46 UC credits in the areas of Natural Sciences, Social Sciences, Humanities, Fine Arts, and Breadth, with a minimum number in each category. Breadth courses aim to develop skills, knowledge and diverse perspectives necessary to interpret and address complex problems; and/or acquire scientific or cultural literacy necessary to be an informed individual who has local and global awareness. Moreover, such courses shall increase the disciplinary, methodological and cultural perspectives available to students in the UC, thereby extending the breadth of their knowledge to navigate successfully a complex and dynamic world.

As a result of personal inquiry and a balanced, purposeful selection of courses representing diverse perspectives, students will:

- demonstrate knowledge of science, cultures, numeracy, history, arts and society.
- develop the skills, knowledge, and diverse perspectives necessary to address the complexity of their Guiding Question.
- acquire the scientific and cultural literacy necessary to be an informed and ethical citizen who can contribute to local and global society.
- reflect on and continue to develop meaning in their own lives and to see meaning in the lives of others.

Through a process whereby students:

- practice and compare a balanced mix of disciplinary perspectives across the natural sciences, social sciences, humanities, math, and fine arts.
- progress towards achievement of the Essential Learning Outcomes.
- examine multiple perspectives, environments, and cultures ranging from the local to the global.
- interpret complex problems and challenges in novel ways, engendering and nurturing the habit of a flexible and open mind that seeks new opportunities and conceives new solutions.

It should be noted that all GSCP students will have their Guiding Question aligned with their selected Grand Challenge. As of the start of the 2017/18 academic year, all faculty advisors at the School of Engineering have been asked to work with their advisees to ensure the alignment of the UC breadth courses with their Guiding Question. In a pre-advising email, advisors ask their advisees to come to the advising session with a short list of UC courses, as well as a justification of how these particular choices contribute to their Guiding Question. For GC Scholars, the Guiding Question stems from a Grand Challenge and the choice of UC courses still has to contribute towards this Guiding Question.

One of the requirements of the UC courses in Humanities, Social Science, Fine Arts, and general Breadth courses is to have a reflection at the end of the course. In the case of our GC Scholars, a separate reflection will be required for each course taken in Humanities, Social Science, Fine Arts, and general Breadth. These reflections will include a discussion on how the learning from the particular course contributed to the overall knowledge sought on their perspective Grand Challenge. GC Scholars will include these reflections on their GCSP portfolio.

### **Business/Entrepreneurship**

Because it is important for students of all disciplines to understand the way business functions in our world and the process of commercializing new technologies, all GC Scholars at Quinnipiac University will be required to complete some form of business/entrepreneurial activity. There are three approved activities for GC Scholars:

- 1) Have an experience from the School of Business:
  - Successful completion of a course from a list approved by the GCSP Committee.
  - Successful completion of a Field Project through the Department of Entrepreneurship and Strategy, equivalent to an independent study for three credits.
- 2) Student can secure an internship or other experience that allows them to gain understanding that viable business models are necessary for successful implementation of GC solutions. This internship, or equivalent experience, should be a minimum of 100 hours. Prior to starting, the student needs to provide an overview of the experience as well as a signature of the supervisor/mentor. The GC Director should approve the internship to ensure the necessary understanding into business functions can be gained.
- 3) Other opportunities as approved by the GCSP Director.

While it is up to the student to choose the best means to satisfy the Business/Entrepreneurship competency, the students will submit a reflection to connect their chosen means and their perspective Grand Challenge. The GC scholars will submit this reflection to their GCSP portfolio.

### **Multicultural Understanding**

All Quinnipiac students are required to take one course within the University Curriculum that are designated as Intercultural Understanding courses. GC Scholars will be required to complete an additional global awareness activity in order to understand the global aspects of the problem they are trying to solve and the contextual challenges to implementing solutions. Acceptable activities will include:

- 1) Studying abroad, either for a complete semester or as part of a short-term service or faculty-led program abroad through the Department of Cultural and Global Engagement;
- 2) Completing a summer internship abroad;
- 3) Traveling abroad as part of the Integrative Capstone course;
- 4) A virtual Study Abroad experience, similar to the one offered in our current MBA course, Decision Making in a Global Economy, MBA 660;
- 5) Any other global dimension activity proposed by the student that is approved by GCSP Director.

Upon completion of any of the aforementioned activities, the students have to submit a reflection, describing their learning from the experience, how it has led to their personal growth, how it relates to their particular Grand Challenge of choice, and why an understanding of multiculturalism is an essential component of their journey as a GC Scholar. GC Scholars will include this reflection in their GCSP portfolio.

### **Social Consciousness**

Community service is woven into the fabric of Quinnipiac's culture. Our student organizations and Greek chapters regularly engage in a variety of service projects in the community. From

canned food drives to neighborhood cleanups, there's always an opportunity to get involved. Our Alternative Spring Break program allows Quinnipiac students to dedicate their break to making a difference, while learning about themselves, their classmates and the pressing needs of our communities. Quinnipiac also takes part in "The Big Event," a nationwide day of community service when colleges and universities send teams out to volunteer in the community.

All GC Scholars will be required to complete a social consciousness experience to ensure they understand their responsibility to the public as an engineer and as a citizen, as well as to better understand the contextual challenges associated with implementing technical solutions. GC Scholars may choose to achieve this social consciousness experience in a theoretical or an experiential manner. Those who choose the theoretical route will take on a set of approved courses within identified programs to increase their academic knowledge of major societal issues. Those GC Scholars who choose the experiential route may not gain any theoretical knowledge but will work within an identified framework to make a difference and serve society.

Upon completion of their experience, students submit a reflection, describing their learning from the experience, how it has led to their personal growth, how it relates to their particular Grand Challenge of choice, and why they consider this experience to be an essential component of their journey as a GC Scholar. GC Scholars will include this reflection in their GCSP portfolio.

Acceptable activities will include:

- 1) Logging a total of 30 hours of community service approved by GCSP Director;
- 2) Participating in an approved week-long service trip;
- 3) Participating in the "Scholars at Quinnipiac University Integrating Difference", (SQUID), program and receiving a certificate. Many students seek out opportunities to learn about people in societies who have been historically underrepresented and underprivileged. This certificate program, offered through the College of Arts and Sciences, is designed to acknowledge the effort students have made to learn about the broad variety of human experience.
- 4) Receiving a Service Learning Certificate through the University Committee for Service and Service Learning. To earn a Service Learning Certificate, students must successfully complete (grade of C or better) three or more Service Learning designated courses at Quinnipiac, or two Service Learning designated courses along with a service experience or service trip with a reflection component. Each semester, there is a list of SL-designated courses available for the students to choose from.
- 5) Completing a senior design project or other project that involves significant service learning, as approved by GCSP Director. Quinnipiac SoEng already has a track record in this. In the 2016-17 academic year, we had two senior design teams whose project had a significant service learning impact. One focused on the Children's Backpack Program at the Connecticut Food Bank where food is distributed to school children in need. The second focused on an eco-brick project in Guatemala where a tool was developed for packing trash into bottles that can then be used for construction;
- 6) Another significant service-learning experience approved in advance by the GCSP Director.



## **Selection and Program Management:**

A subset of the current students in the School of Engineering will be invited to apply to the GCSP late in the Spring term of each academic year. The great majority of these students will be in their sophomore or freshman year of their program. Juniors may apply, provided they can justify a realistic chance of being able to satisfy all the GCSP requirements in their senior year. This is most likely applicable to those students who have gained various activities, such as service trips, and can retroactively apply them to their GCSP after officially joining the program.

The GCSP Committee will hold a meeting each spring to inform interested students of the GCSP and the application process. Each applicant will be required to submit:

- A completed application form;
- Two essays, one relating to the student's interest in the Grand Challenges and the other on importance of social and/or global issues;
- Two faculty members who can be contacted by the GCSP committee as reference.

Selection decisions will reflect the desire for GC Scholars to be a diverse cohort of intellectually strong students with demonstrated passions for one or more Grand Challenges. Once selected to be part of the GCSP, each student will meet at least once per semester with a member of the GCSP Committee to confirm the student is making sufficient progress towards completing GCSP requirements. For our first year in the 2018-19 academic year, we expect 5% of the sophomores and juniors to show a strong interest and be eligible to join the GCSP. Our current sophomore class is almost 100 students and the current freshman class is about 130. We can expect around 15 students in the GCSP in our inaugural year. For our first year, we met in April 2018 and defined the following rules for inviting students. We will evaluate the participation and quality and possibly modify the selection criteria in Spring 2019.

- a freshman with GPA > 3.8; or
- GPA  $\geq$  3.2 *and* one of the following:
  - has done a study abroad or a course with an abroad experience, or is registered to do so in summer 2018
  - has done a service trip, or is registered to do so in summer 2018
  - is currently, has been, or is elected to be, on the executive board of an SoEng student organization
  - has done a research project with a faculty or will do so in summer 2018.

Seniors in the GCSP will be expected to participate in the School of Engineering Projects Day to be held each May. Each senior will present how they achieved the required components of the GCSP through a poster or formal presentation. In addition to covering the various components of their journey, including the competency areas, students are expected to discuss at length how the various components are connected to provide a learning experiences that is at a higher level than the sum of the individual components. In addition, each senior GC Scholar will be required to create an e-portfolio that will be featured on the GCSP website. This website will provide information regarding the various aspects of the program for potential applicants and interested alumni. It will also provide GCSP underclassmen with examples of how past GC Scholars have been successful.

Dr. Corey Kiassat, Associate Dean of SoEng, will serve as the Director of GCSP. He will form a GCSP committee, consisting of one volunteer faculty member from each of the programs within SoEng. Whenever possible, the committee members also teach one section of the ENR 410 capstone course, focusing on a grand challenge of interest. Thus far, we have had several faculty members who have expressed a strong interest to be involved, four of whom have already gone through a Systematic Design of Instruction workshop in June 2017 to design the initial framework of their senior-level ENR 410 course. Several other faculty have also been quite involved with the grand challenges through their involvement with the freshman-level ENR 110 course.

The director is responsible for establishing GCSP, forming the committee, chairing the committee, and providing support to the committee as the liaison with upper administration. This support includes working with the Dean of SoEng to secure funding and space for the GCSP. The GCSP committee will select the students for the program, interact with Department Chairs and Deans from other Schools/Colleges at Quinnipiac to attract non-SoEng students, and organize student activities. It should be noted that while non-SoEng students are not in the GCSP, they are highly encouraged to participate in various aspects of the program, such as the introductory World of An Engineer course and the senior-level Integrated Capstone. The participation of these students enriches the experience of the SoEng students and provides a multidisciplinary perspective.

Students will be encouraged to form a GCS organization and have events and activities on a continual basis to build a community, to learn from each other, and to collaborate on various projects. Similar to current student organizations within SoEng, the organization will be student-run, with a faculty advisor, and will be recognized by the Student Government Association (SGA), thus receiving a budget. Examples of activities within the organization are speaker events and site visits, focusing on a popular grand challenge, as selected by the scholars. Other activities are short-term and semester-long study abroad opportunities, service trips, and internships abroad. The faculty advisor for the GCS organization will fulfill the traditional role played by faculty advisors for the various student organizations in SoEng. They provide guidance to the organization's executive board on achieving their initiatives and to help remove obstacles along the way. In the early stages of the organization's life, the faculty advisor will go beyond these duties and make suggestions on initiatives to pursue.

The GCSP committee members liaison with faculty members who head the major-specific Senior Design or Independent Studies that GCSP students may want to use towards their competency requirements. As of Fall 2018, there is a Living-Learning community that allows a select number of SoEng students to live in the same dormitories. These students will have access to a Makerspace and can focus on the grand challenges in their community.

In terms of planning and tracking of the performance of individual students, each member of the committee will work with the students within their major. This is similar to the one-on-one academic advising already in place at Quinnipiac. The committee members will have a minimum of one meeting per semester with each of their assigned GCSP students to track progress, to plan upcoming activities, and to discuss the milestones in completing the GCSP requirements. As the

director, Dr. Kiassat is responsible for approving successful completion of the GCS program and conveying this information to the national steering committee.

## **Resource Plan**

A proposal for the ENR 410 course has already successfully passed through the various approval committees at the university. This proposal includes space, faculty, and monetary resources and the Provost has agreed to provide the resources.

In terms of space, a collaborative classroom will be dedicated to the SoEng to run the ENR 410 class sections. When these classes are not in session, GC scholars can utilize the space for discussions or club activities. We plan to teach various sections of ENR 410 using our full-time faculty. We plan to use adjunct professors to teach some of the lower-level courses to enable the full-time faculty to be directly involved with the Grand Challenges. In addition to covering for the faculty teaching ENR 410 sections, the adjuncts will also cover a one-course release per semester for the coordinator of the ENR 410 classes. The ENR 410 plan also includes momentary resources for supplies for rapid prototyping as well as printing costs for posters and other display materials during fairs.

The School of Engineering has had a tradition of providing funding for summer research. In the summers of 2015 and 2016, the Dean of SoEng provided about \$40,000 to support faculty and students in undergraduate research projects. Starting in summer 2019, and continuing into the near future until alternative sources of funds can be secured, the funds will support GCSP-related research as the primary focus. Furthermore, there is a university-wide source of funding that supports undergraduate summer research. Multidisciplinary research proposals are given priority. Therefore, GC scholars in the SoEng can work with non-engineering student(s) to apply for research funding. In addition to research funding, the Dean of SoEng will provide funding for the GCSP Director to attend national GCSP events each year.

Quinnipiac currently has a Department of Cultural and Global Engagement. Among the services they provide are setting up Study Abroad opportunities. There have been several SoEng students who have used the services of this department to do a semester abroad. We will continue to work with this office as GC scholars pursue semester-long or short-term study abroad opportunities. The costs for such opportunities has traditionally been provided by the student. This department also provides opportunities for service trips. In the past, we have had SoEng students who have gone on such trips. They are mostly one week in length and are funded by the students. The School of Business and SoEng share Career Development personnel. They can help our students with finding internships outside the United States. In addition, we have started the discussions with companies, such as City Internships, that can help students find internships in cities across the United States and various metropolitan areas in the world.

As the GC scholars form an organization and get it approved by the SGA, they will have some budget and planned events. The organization can fund its meetings and speaker events and provide the scholars with food and beverages. They can also arrange site visits to relevant and interesting companies and provide transportation for such visits. During the first year of establishing the organization, it will not be recognized by the SGA as the charter will be approved the following year. In the organization's first year, the Dean of the SoEng will provide

funding for food and beverages for the meetings, as well as transportation for site visits. In the long term, the Director of the GCSP will seek additional funding from industry partners and government organizations, such as NSF International Research Experiences for Students and NSF Research Experiences for Undergraduates.

### **Closing**

The Grand Challenge Scholars Program is aligned with Quinnipiac University's General Education mandates, as well as the School of Engineering's curriculum, framework, and culture. The GCSP and its associated elements will benefit all the students in the School of Engineering and many students at Quinnipiac University as a whole. The program will enrich the education and lives of our students and contribute to them becoming better citizens. We are confident that Quinnipiac University School of Engineering has the commitment and resources necessary to start and sustain a successful GCSP.

## Appendix 1

### **Example of Assignment in the introductory World of an Engineer course, centered on the Grand Challenges:**

For the previous assignment on the Grand Challenges for Engineering, your team presented the nature of a selected Grand Challenge, the difficulties involved in addressing it, the necessity to address it from a multidisciplinary perspective, and its impact on society. During the next two weeks, you and your team will delve into the technical engineering aspects of the same challenge and propose an approach for tackling that Grand Challenge by synthesizing techniques from the four engineering disciplines offered at QU.

#### **Instructions:**

The final deliverable for this assignment will be a **15-17 minute oral presentation** in class on Thursday, December 7<sup>th</sup>. The presentation must have the following structure:

- 1) A brief **overview** of the selected Grand Challenge. What is it, why is it difficult and at the same time important?
- 2) An **issue map** that lists at least a couple of issues/current limitations associated with the selected Grand Challenge in each of the following categories: Political, Economical, Religious, Media, Social, and Technological
- 3) A **proposed approach** for tackling the selected Grand Challenge. This approach must use **techniques/recent technological advancements from each of the four engineering disciplines** at QU: Civil, Industrial, Mechanical, and Software Engineering
- 4) A **discussion of what role engineers from each of the above disciplines will play** in the proposed approach and how they will **cooperate in a multidisciplinary team**
- 5) A description of which issues/limitations from the issue map the proposed approach will address and how it will address them
- 6) A description of the issues with/limitations of the proposed approach itself and a discussion of how these issues/limitations could be potentially addressed with future research and development

As you prepare your presentation, make sure to closely follow the oral presentation techniques described during the *Oral Presentations and Teamwork* lesson. Provide a reference to the sources that back up the claims you make or the facts you include in your presentation.

## Appendix 2

### Example Syllabus of an Integrative Capstone Course, Centered on a Grand Challenge:

#### ENR 410 School of Engineering Integrative Capstone

<b>Class Time:</b>	TBD
<b>Class Location:</b>	TBD
<b>Office Hours:</b>	TBD
<b>Instructor:</b>	Dr. John E. Greenleaf Email: <a href="mailto:John.Greenleaf@quinnipiac.edu">John.Greenleaf@quinnipiac.edu</a> Phone: (203) 582-5018 Office: Center for Communications and Engineering, LL310
<b>Required Text:</b>	None
<b>Class Type:</b>	TBD
<b>Credits:</b>	3
<b>Prerequisite(s):</b>	FYS 101/FYS150, EN 102, UC Math (3 credits), UC Science (4 credits), Senior status in the major, 6 credits of Hum/SS/FA completed

**Course Description:** ENR 410 provides students with a culminating and integrative learning experience grounded in their University Curriculum, their major classes, and co-curricular activities. Students will explore and evaluate potential solutions to an aspect of one of the 14 Grand Challenges for Engineering, with a focus on the global dimension of the solution. The course may include a service learning or study abroad component.

The National Academy of Engineers has defined the 14 Grand Challenges to be the following: 1) Advance Personalized Learning; 2) Make solar energy economical; 3) Enhance virtual reality; 4) reverse-engineer the brain; 5) Engineer better medicines; 6) Advance health informatics; 7) Restore and improve urban infrastructure; 8) Secure cyberspace; 9) Provide access to clean water; 10) Provide energy from fusions; 11) Prevent nuclear terror; 12) Manage the nitrogen cycle; 13) Develop carbon sequestration methods; 14) Engineer the tools of scientific discovery. More information can be found here: <http://www.engineeringchallenges.org>

This particular section of this course focuses on the Grand Challenge “Providing access to clean water”.

**Course Learning Outcomes (CLO):** Upon completion of this course students will:

1. Reflect on, recognize and communicate how their general education coursework, classes in their major, and co-curricular activities worked together to create an integrated and intentional learning experience.

2. Reflect on, recognize and communicate how their Personal Quest has provided insight into and further understanding of their Guiding Question and how it relates to their personal and professional goals.
3. Apply the knowledge and skills gained in their overall learning experience to a deeper understanding of a complex question(s), problem(s), or challenge(s) from multiple perspectives.
4. Explain the importance of determining solutions to problems associated with the Grand Challenges (why are these the Grand Challenges and why are they important)
5. Identify and acquire new knowledge that contributes to a deeper understanding of a Grand Challenge.
6. Evaluate potential solutions to a problem identified as an aspect of a Grand Challenge in terms of its technical, ethical, social, and/or political implications.
7. Operate as an effective leader or team member on a multi-disciplinary project team.
8. Communicate the solution clearly through writing, drawing, and/or speaking.

### **QU ELOs Addressed:**

**Written Communication** - An ability to think critically, clearly, and creatively in written expression in areas of interest and expertise. *(Addressed by CLO 8)*

**Oral Communication** - An ability to think critically, clearly, and creatively in oral expression in areas of interest and expertise. *(Addressed by CLO 8)*

**Responsible Citizenship** - An ability to recognize, analyze and influence decisions and actions at the local, national and global community level, and to engage in the community as responsible citizens. *(Addressed by CLOs 4-6)*

**Diversity Awareness and Sensitivity** - An understanding of and respect for the similarities and differences among human communities. This includes a recognition and appreciation for the unique talents and contributions of all individuals. *(Addressed by CLO 7)*

**Social Intelligence** - An ability to work effectively with others, to understand and manage interactions, and to act ethically, constructively, and responsibly to achieve individual and common goals *(Addressed by CLO 7)*

**Critical Thinking and Reasoning** - An ability to recognize problems, and to acquire, assess and synthesize information in order to derive creative and appropriate solutions. *(Addressed by CLOs 3-6)*

**Scientific Literacy** - An ability to understand and apply scientific knowledge in order to pose and evaluate arguments based on evidence and to make decisions and express positions that are scientifically and technologically informed. A scientifically literate person is able to evaluate the quality of scientific information on the basis of its source and the methods used to generate it. *(Addressed by CLOs 3-6)*

**Quantitative Reasoning** - An ability to represent mathematical information symbolically, visually, numerically, and verbally, and to interpret mathematical models such as graphs, tables, and schematics in order to draw inferences. Also, an ability to use arithmetical, algebraic, geometric, and statistical methods to solve problems. *(Potentially addressed by CLOs 5-6)*

**Information Fluency** - An ability to find and critically evaluate information from various media, to analyze it, and communicate outcomes in the process of solving problems in a changing and complex world. Also, an ability to use information and computer literacy skills to manage projects and conduct rigorous inquiry. (*Addressed by CLO 5*)

**Creative Thinking** - The capacity to combine or synthesize existing ideas, or expertise in original ways and the experience of thinking, reacting, and working in an imaginative way characterized by a high degree of innovation, divergent thinking, and risk-taking. (*Addressed by CLO 6*)

**Visual Literacy** - The ability to interpret visual messages and/or to create such messages in ways that advance thinking, decision-making, and communications. Visual Artifacts include, but are not limited to: electronic media, art, charts and graphs, diagrams, maps, metaphors, data, concept, information, strategy, and compound. (*Addressed by CLOs 5,8*)

**ABET Student Outcomes Addressed:**

- 1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- 2) an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- 3) an ability to communicate effectively with a range of audiences
- 4) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
- 5) an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
- 6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- 7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

**Grade Composition:**

<u>Grade Composition</u>	<u>Value (%)</u>
Gen Ed Written Reflection (CLO 1)	<b>10%</b>
Personal Quest/Guiding Question Reflection (CLO 2)	<b>10%</b>
Signature Work	<b>80%</b>
Lit Review/Background Research (CLO 3)	5%
Outline Preparation	5%
Signature Work (Draft #1)	5%
Signature Work (Draft #2)	10%
Brainstorming, Prototype, drawings, model	10%
Participation (class discussions, exercises, etc.)	5%



Oral Presentation	10%
Debate/Summit	5%
Paper or report appropriate to project	20%
Poster (and poster presentation)	5%

<u>Grade Range (%)</u>	<u>Grade</u>
93-100	A
90 -92	A-
87-89	B+
83-86	B
80-82	B-
77-79	C+
73-76	C
70-72	C-
60-69	D
<60.00	F

**Course Outline:** Schedule of events is subject to change; please see Blackboard for updates.

<b>Week 1</b>	Introduction to Grand Challenge (section-specific) and Issue Mapping (Water – Technical Issues)
<b>Week 2</b>	Issue Mapping (Economic & Social Issues)
<b>Week 3</b>	Issue Mapping (Global Issues)
<b>Week 4</b>	Current Water Issues (Oral Presentation)
<b>Week 5</b>	Flint, MI Case Study (Introduction)
<b>Week 6</b>	Flint, MI Case Study (Research)
<b>Week 7</b>	Flint, MI Water Summit (Solution/Recommendations)
<b>Week 8</b>	Grand Challenge work (Brainstorming/Ideation)
<b>Week 9</b>	Grand Challenge work (Concept Design/Critique)
<b>Week 10</b>	Grand Challenge work (Preliminary/Schematic Design)
<b>Week 11</b>	Grand Challenge work (Prototype/Development/Test)
<b>Week 12</b>	Grand Challenge work (Prototype/Development/Test)
<b>Week 13</b>	Grand Challenge work (Evaluate/Reflect)
<b>Week 14</b>	Present results
<b>Week 15</b>	Final reflection

## **Policies and Procedures**

**QU Academic Integrity:** This class operates within the framework set by the five fundamental values of Quinnipiac University's academic integrity policy: honesty, trust, responsibility, fairness and respect. The practice of these values while executing academic work fosters the development of professional integrity. To that end, all assignments submitted shall be considered graded work and shall be completed on an individual basis unless otherwise stated. Discussing assignments and seeking help outside of class is both authorized and encouraged. However, copying / sharing solutions from any source (including online solution manuals) or reusing a computer file in full or in part is dishonest and unfair to other members of the class. Students are responsible for seeking clarification if there is a question about applying the values of academic integrity to particular work. When in doubt about policies on issues about plagiarism or collaboration, consult the course instructor. Suspected violations of academic integrity shall be dealt with according to standard university practice. Lack of knowledge of this policy is not an acceptable defense to any charge of academic dishonesty. Refer to <http://www.quinnipiac.edu/about/university-policies/academic-integrity/> to access the official University policy and procedures.

**Accommodations for Students with Disabilities:** In compliance with equal access laws and University policy, the instructor is available to discuss the necessary accommodations for documented disabilities. If a student chooses to disclose a learning disability, please see John Jarvis, Coordinator of Learning Services, by phone at 203-582-5390 or by email at [john.jarvis@quinnipiac.edu](mailto:john.jarvis@quinnipiac.edu) to initiate the process of disclosure. It is the responsibility of the student to arrange for requested accommodations with the faculty and the Learning Commons (if required) well in advance of any activity where it may be needed.

**Class Preparation:** Study guides (i.e. Lesson 1 Study Guide) shall be posted on Blackboard prior to each class. These guides provide the students with an idea of what is coming up in the next session. In addition, the guides contain learning objectives and any combination of assigned readings, tutorials, thought problems and homework assignments. Assigned readings familiarize students with terms and concepts to be covered. Completing the assigned reading prior to class promotes understanding of the material presented during the instruction, and it provides information not covered in class. Tutorials and thought problems prepare students for activities or problem solving in class. Readings, tutorials, and thought problems should be completed prior to class as indicated in the study guide for each lesson.

**Homework:** Details of each assignment, including due dates and times, will be available in ASSIGNMENTS on Blackboard. Homework will be completed on paper unless otherwise indicated. Accuracy, neatness and format will be evaluated in determining assignment scores. Formatting details will be provided when appropriate. Homework submitted after the indicated date and time is late.

**Late and Missed Submissions:** It is a basic principle of the engineering profession that “**professionals are not late.**” Therefore, ENR 410 maintains a strict late policy—late homework receives a ZERO (0). Of course, special circumstances arise that require an extension (illness, family tragedies, mandatory athletic trips, job interviews, conferences). In such situations, coordinate with the instructor in advance of the due date. The instructor can adjust the due date as appropriate.

**All requests to submit late or missed work must be made with the instructor within one week of the assignment due date and must be made at least two days prior to missing the assignment for school sanctioned events such as athletic team trips, job interviews or conference trips.**

**Mandatory Completion:** To ensure student learning, all assignments, labs and projects assigned in ENR 410 must be completed by final's week. This requirement applies even if the work will receive a zero grade as a result of late submission or other circumstances. Failure to submit all work may result in an incomplete (I) grade in the class.

**Website:** Each student has access to a Blackboard site for this course. All course documents and assignments shall be posted to these sites. Students should regularly check Blackboard for course material, assignments and announcements.

**Electronic Submissions:** Any electronic submission found to contain a virus or other malware receives an automatic ZERO. Keep virus protection and other security software current!

**Course Attendance:** Class attendance is highly recommended. Multiple activities meant to enhance student understanding of material introduced in readings occur in class. Some elements of these class activities become part of homework or other assignments. Material missed due to failure to attend class is entirely the student's responsibility. Accommodations are of course possible for students suffering from illness, family tragedy or mandatory athletic commitments.

**Communication:** When communicating with an instructor, please follow these guidelines, which improve response time and encourage professional communication. Use a QU email account to help avoid mail being filtered to junk mail. Each email message should include ENR 410 in the subject line. In the signature of the email, provide a first name, last name, class day and time.

## Appendix 3

### Summary of the Grand Challenge Scholars Program’s Required Components:

	<b>Options</b>
<b>Hands-On Project or Research Experience</b>	<p>Complete one of the following and submit a reflection to GCSP portfolio to discuss connection between experience and chosen grand challenge:</p> <ol style="list-style-type: none"> <li>1) A project within ENR 410, Integrative Capstone course.</li> <li>2) A research project or an Independent Study with a faculty member over a summer or one or more semesters.</li> </ol>
<b>Multidisciplinary Curriculum</b>	<p>Complete EACH of the following and submit a reflection to GCSP portfolio to discuss connection between experience and chosen grand challenge:</p> <ol style="list-style-type: none"> <li>1) ENR 110, The World of an Engineer</li> <li>2) FYS 101, First Year Seminar</li> <li>3) ENR 410, Integrative Capstone</li> <li>4) Complete UC requirements related to student’s Grand Challenge of choice</li> </ol>
<b>Business/Entrepreneurship</b>	<p>Complete ONE of the following activities and submit a reflection to GCSP portfolio to discuss connection between experience and chosen grand challenge:</p> <ol style="list-style-type: none"> <li>1) One course taught within the School of Business, from a list approved by the GCSP Director</li> <li>2) a Field Project through the Department of Entrepreneurship and Strategy, equivalent to an independent study for three credits</li> <li>3) an approved internship or other experience that allows them to gain understanding that viable business models are necessary for successful implementation of GC solutions</li> <li>4) other, as approved by GCSP Director</li> </ol>
<b>Multicultural Understanding</b>	<p>Completing ONE of the following activities and submit a reflection to GCSP portfolio to discuss connection between experience and chosen grand challenge:</p> <ol style="list-style-type: none"> <li>1) Studying abroad, either for a complete semester or as part of a short-term service or faculty-led program abroad through the Department of Cultural and Global Engagement;</li> <li>2) A summer internship abroad;</li> <li>3) Traveling abroad as part of the Integrative Capstone course;</li> <li>4) A virtual Study Abroad experience, similar to the one offered in our current MBA course, Decision Making in a Global Economy, MBA 660;</li> <li>5) Any other global dimension activity proposed by the student that is approved by GCSP Director.</li> </ol>

<b>Social Consciousness</b>	Completing ONE of the following activities and submit a reflection to GCSP portfolio to discuss connection between experience and chosen grand challenge: <ol style="list-style-type: none"><li>1) an approved 30 hour community service project</li><li>2) an approved week-long service trip</li><li>3) a certificate in Quinnipiac University's "Scholars at Quinnipiac University Integrating Difference", (SQUID), program</li><li>4) a Service Learning Certificate through the University Committee for Service and Service Learning</li><li>5) an approved senior design project or other project that involves significant service learning</li><li>6) another service-learning experience approved in advance</li></ol>
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