

# SANTA CLARA UNIVERSITY



## National Academy of Engineering Grand Challenges Scholars Program Proposal

Elaine Scott, Ph.D.  
Dean of Engineering  
Santa Clara University

Directed by:  
Jessica Kuczenski, Ph.D.  
GCSP Director  
Director of General Engineering  
School of Engineering  
Santa Clara University  
[jkuczenski@scu.edu](mailto:jkuczenski@scu.edu)  
408-551-3337

# Santa Clara University Grand Challenges Scholars Program Proposal

## Executive Summary

The Grand Challenges Scholars Program is a nationally recognized program offered as part of the National Academy of Engineering (NAE). With this program, NAE has sparked ‘a global movement’ driven by its aspirational vision which calls for engineering to serve people and society by working towards the “continuation of life on the planet, making our world more sustainable, secure, healthy, and joyful”<sup>1</sup>. This aspirational vision is well-aligned with SCU’s Jesuit Mission and values, empowering our students to improve and enhance their leadership skills and increase their social/global awareness. Overall, The Grand Challenges Scholars Program is well-aligned with SCU and its Jesuit mission, curriculum, and culture of educating the whole person in order to build a more humane, just and sustainable world.

The following proposal outlines the SCU Grand Challenges Scholars Program including its essential program elements, program management, and completion requirements. The program elements will be managed and assessed through Portfolium which has already been funded and made available for the entire SCU community. Funding requirements for this program are very low, leveraging existing programming and design opportunities and experiences already offered at SCU. The School of Engineering stands ready to launch SCU GCSP that will help our students connect the Grand Challenges with their education, their career, their public service, and their lives.

## 1. GCSP Vision, Mission and Goals

Santa Clara University’s mission is to “educate citizens and leaders of competence, conscience, and compassion and cultivate knowledge and faith to build a more humane, just and sustainable world.” In brief, SCU’s mission is to educate the whole person within the Jesuit, Catholic tradition, making student learning our central focus. We do this by continuously improving our curriculum and co-curriculum, strengthening our scholarship and creative work, and serving the communities of which we are a part in Silicon Valley and around the world. The proposed Grand Challenges Scholars Program (GCSP) at SCU aligns well with and strengthens the University’s mission by empowering our students to improve and enhance their leadership skills and increase their social/global awareness.

The GCSP program provides a strong mechanism for motivating our students to engage more deeply with their learning during their time at SCU. The National Academy of Engineering’s fourteen grand challenges serve to identify issues that, if solved, will greatly benefit humanity. Furthermore, scholars may work to connect their plan and GC experiences in each of the five competencies to the aspirational vision for what engineering needs to deliver to all people on the planet in the 21st century as quoted below:

*“Continuation of life on the planet, making our world more sustainable, secure, healthy, and joyful.”*

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<sup>1</sup> NAE GCSP website, retrieved May 3, 2019, URL: <http://www.engineeringchallenges.org/GrandChallengeScholarsProgram.aspx>

This furthers the School of Engineering’s Mission to “educate engineers empowered with the ability to drive and address the greatest challenges of the 21st Century”. Our GCSP program will provide opportunities to engage, understand and help address solutions to these ‘sticky’ global challenges, while inspiring innovative ideas and designs that will help people around the world achieve a higher standard of living and quality of life.

## 2. Essential Program Elements of GCSP

In this section we describe how SCU GCSP scholars will fulfill the main components of the program, as described by the National Academy of Engineering (NAE). We plan to leverage many facets of the current curriculum and co-/extra-curricular activities which already directly contribute to opportunities for a Grand Challenges Scholars Program. Furthermore, this section also details the institutional governance, sustainability, and assessment for the GCSP at SCU. The rough timeline for the program is shown in Figure 1.

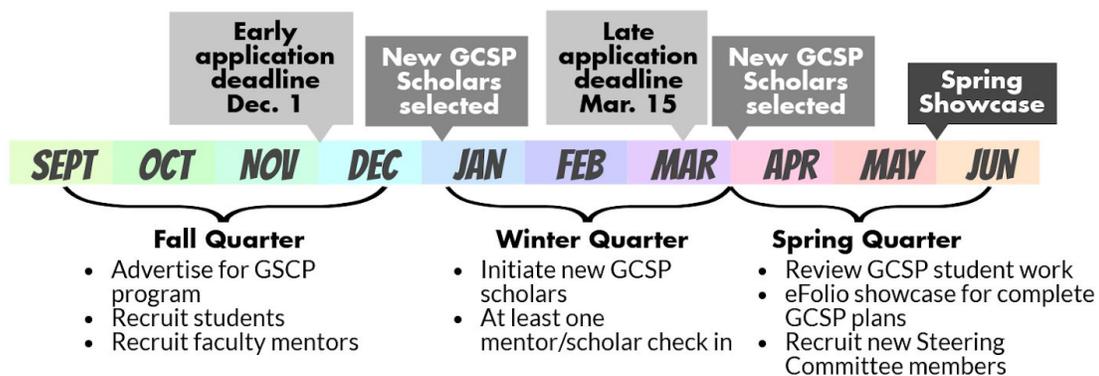


Figure 1: GCSP academic timeline

### 2.1. GCSP Scholar Recruitment and Selection

The GCSP at SCU is designed to attract students who are excited about pursuing answers to challenges that face humanity and making the world a better place for all. In this spirit, the SCU GCSP program is open to all students in good academic standing<sup>2</sup>. It is expected that 15-20 new students will start the program each year. Criteria for selection are founded upon a student’s demonstrated willingness to work and commit themselves to the elements of the GCSP.

Specifically, the student must meet the following:

- A. Be a student in “good academic standing”<sup>2</sup>
- B. Create an application for the SCU Grand Challenges Scholar Program. [Appendix 6.1](#) is an example draft application form for students. The application will consist of:
  - a. **Personal essay** (no more than 1 page) on motivation to complete the SCU Grand Challenges Scholar program and the specific GC challenge they want to address.
  - b. **Recommendation(s) from at least one faculty member/mentor.** This letter should address the strengths, talents and motivation of the student that will sustain him/her in completing the GCSP components. Ideally, the mentor will have first

<sup>2</sup> According to the 2019-2020 Santa Clara University Undergraduate Bulletin, “To be in good academic standing at the University, a student must normally be enrolled for 12 or more units, must maintain a cumulative grade point average of at least 2.0 based on all courses taken at Santa Clara, and must have completed at least a minimum number of units as specified below.” <https://www.scu.edu/bulletin/undergraduate/chapter-8/AcademicStandingandStudentClassification.html>

hand knowledge of the applicant’s work habits, persistence, organizational abilities, and independence, all essential to identifying and completing activities to fulfill GCSP requirements. [Appendix 6.2](#) is an example Directive for Recommenders.

- c. **Endorsement** from the student’s academic advisor (or department chair) who is in a position to gauge whether admission to this program is recommended based on current GPA and courses to come.
  - d. **A proposed Grand Challenges faculty mentor.** Initially, the program director and the Grand Challenges Steering Committee will serve as ‘interim’ mentor(s) for all students interested in the program to help guide them and to help identify a mentor that is linked to their project area. Every effort will be made to find a faculty mentor that is well suited for working with interdisciplinary undergraduate students.
  - e. **A proposed Grand Challenges Plan Schedule** that:
    - i. Outlines how the student plans to fulfill each of the five Grand Challenges competency areas as part of their program of study (see [Section 3](#)), along with an explicit statement that connects the five competencies to a GCSP theme (Health, Sustainability, Security, Joy of Living) or a particular Grand Challenge (one of the fourteen). This plan is subject to change as the student works through the components and consults with his/her advisor.
    - ii. Is feasible to be completed in the time remaining prior to the student’s graduation.
- C. The application will be submitted to the GCSP Director by an early December deadline, see Figure 1. An additional mid-March deadline is available for those who were unable to meet the December deadline, as also noted in Figure 1. The submission will occur through Portfolium, which is an electronic portfolio platform already in use by Santa Clara University. All students already have an account created and may access a GCSP digital roadmap through Portfolium, see Figure 2 for a screenshot of the digital roadmap in Portfolium for the application submission.

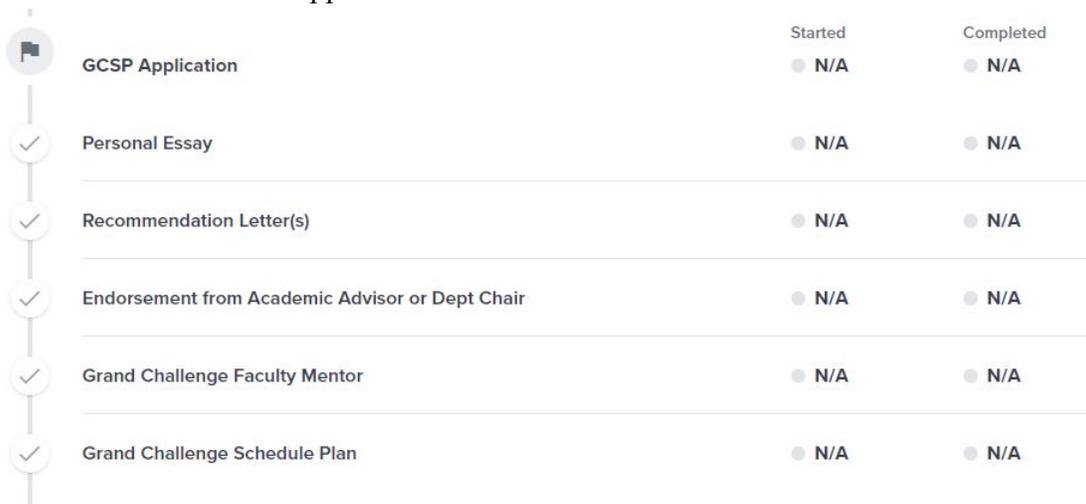


Figure 2: GCSP application digital roadmap through Portfolium

We will recruit students through our first-year Introduction to Engineering coursework, through existing student support activities, such as our Peer Advisor program, and through specific informational sessions held during fall quarter.

## **2.2. GCSP Program Management**

The Global Challenges Steering Committee will review all submitted applications and every attempt will be made to accommodate all students who are interested in participating in the program. The Steering Committee will be composed of the GCSP Director and at minimum one faculty member from each of the undergraduate engineering departments (bioengineering, civil, environmental, and sustainable engineering, computer science and engineering, electrical and computer engineering, and mechanical engineering) appointed by the Dean of the School of Engineering (who will work with the department chairs). Additional (perhaps non-mentoring) Steering Committee members may include individuals directly involved in establishing internships, leading service learning experiences, developing and approving study abroad opportunities, and those teaching in the business school. Selection criteria includes:

- Strength of the proposal - each proposal should include well-thought out plans for addressing each of the elements of the program and linking them together
- Good academic standing with the university<sup>2</sup>
- Academic progress - current sophomore and junior level students will be given priority for selection into the program, however students who are either on a path to fulfilling the required competencies (senior level students) or who are clearly focused early in their academic career on being part of the GCSP (first-year students) will also be considered for admission into the program

The GC Steering Committee will work to select a diverse group of students with strong potential to complete the program requirements and show a driving passion for one or more of the Grand Challenges. If interest in the GCSP is not sufficiently strong among diverse students, the GC Steering Committee will work with the Office of Multicultural Learning and the Office of Diversity and Inclusion to build diverse student interest in becoming a GCSP scholar. We will also specifically recruit students in our LEAD program and other student organizations with strong diverse memberships.

Once admitted, each scholar is expected to remain in good academic standing while a member of the program. To do this, the scholar will work with their mentor to make steady progress towards completing each portion of the program as set forth in their program plan. At least one in-person mentor meeting per quarter is expected to connect with their mentor and evaluate progress towards their GCSP plan completion and make changes as necessary. The Portfolium GCSP digital roadmap will also be utilized to track progress through the program by centralizing the location for competency project approval and completion, see Figure 3 as an example for the ‘Talent’ competency. Students can submit projects for approval (or completion) using Portfolium and mentors and the GCSP Steering committee can review and give feedback as part of the process. Note that these Portfolium digital pathways will only be used internally, thus may be private to all but the Steering committee, as desired and set by the scholar.

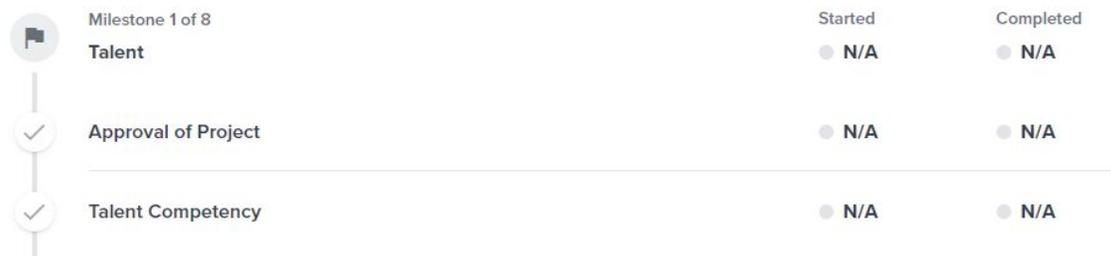


Figure 3: GCSP digital pathway example competency

Furthermore, we expect GCSP scholars themselves to take significant leadership roles in the development and evolution of the program and associated activities. We hope to support (with a faculty advisor) a student-led GCSP organization that would hold regular meetings and events to inform, share, engage, and collaborate with not only the GCSP scholars, but also with the greater SCU student community.

Once a student has completed all portions of the GCSP plan, they, in coordination with their faculty mentor, will notify the Director of completion. Once completion has been verified, the student will create a final showcase electronic portfolio to provide a synopsis of their experiences. These eFolios will be external facing and will highlight portions of student work [that they wish to make public]. [Appendix 6.3](#) has some guidelines for the creation of this ePortfolio. These GCSP electronic portfolios will then be submitted to their faculty mentor and the GCSP Director by June 1 as evidence of their progress through the program.

Lastly, SCU will hold a showcase each year in the spring to feature the GCSP scholars. Senior level students will be expected to share selections of their work via a display, poster, or other presentation at this showcase, and this work will additionally be featured on our GCSP website in order to provide information regarding various aspects of the program for potential applicants and interested alumni, as well as provide GCSP underclassmen with examples of how past GCSP scholars have been successful. After the spring showcase, the scholar will be formally named a SCU GCSP Scholar. Each year, GC scholars will be issued a special graduation cord and be specifically noted in the University graduation program.

### 3. GCSP Experiences

Each Grand Challenges plan must satisfactorily address the five Grand Challenges competencies required by the GCSP. Furthermore, scholars will work to connect their plan and GC experiences thematically through a specific Grand Challenge (one of the fourteen) or a chosen GCSP theme (Health, Sustainability, Security, Joy of Living). *Please note that any single experience cannot be used to demonstrate multiple competencies in the GCSP, e.g. senior design capstone cannot be used to fulfill both Talent and Interdisciplinary competencies, though longer term meta experiences could be parsed and used to demonstrate multiple competencies.* Details for each Grand Challenge competency is as follows:

#### 3.1. Talent

The goal for this requirement is ensuring that depth of understanding and exposure to at least one Grand Challenge Area is attained by each scholar. Therefore, all GCSP scholars

will be required to participate in an approved research or project-based experience related to a Grand Challenge area. Research and projects can be individual or team based with a scope that is commensurate to the number of scholars involved. This project will have a sustained duration of one academic year or other similar significant time period, such as a full time summer project. An estimated total of greater than 150 hours is expected.

Some examples of the experiences that may support student development of the Talent Competency include participation in formal undergraduate research programs, capstone design projects, or other significant research experiences such as Research Experiences for Undergraduates (REUs) sponsored by NSF and the like. To be an approved project, the scholar must submit a description of the project including the scope, anticipated learning objectives, and a narrative of the broader impacts of the student's participation in the project.

### **3.2. Multicultural**

Multicultural awareness is necessary for working effectively in an increasingly interdependent world. Participating in this competency area will deepen a student's consciousness and motivation to bring technical knowledge to bear on global problems. This experience could be overseas or in an underserved domestic community. It may also be fulfilled through core curriculum as part of the Experiential Learning for Social Justice coursework. As a Jesuit University, SCU has a broad array of opportunities available to the students through our [Global Engagement Office](#). A list of these opportunities include:

- Study Abroad
- Global Fellows Internship
- Global Social Benefit Fellowship
- Immersion experiences
- Registered Student Organizations, including Engineers without Borders, Engineering World Health or any other RSO with a global or underserved community partnership

To ensure significant breadth and depth of experiences, credit for the Multicultural GC competency assumes a minimum of 6 weeks full-time experience or at least one quarter (10 weeks) of part-time experience.

### **3.3. Interdisciplinary Experience**

Bridging engineering to other disciplines is essential for solving the NAE Grand Challenges. SCU experiences, as part of its Jesuit liberal arts background, are designed to build connections amongst fundamental science, mathematics, and engineering, but also amongst different fields of engineering, the arts, humanities, and social sciences, among others. All SCU students spend at least ~25% of their credit hours on liberal arts coursework as part of our Core Curriculum and must complete a Pathway. Pathways are clusters of courses with a common theme that provide an opportunity to study that theme from a variety of disciplinary or methodological perspectives. The purpose of the Pathway is to perceive connections, complexities, and relationships among ideas and a student's educational and life experiences.

All GCSP scholars will be required to fulfill the Interdisciplinary competency through completion of **two** of the following:

- Successful completion of a Pathway, including passing coursework (3 approved courses) and successful submission and acceptance of the Pathway essay. Both chosen coursework and the Pathway essay must be explicitly connected not only to their Pathway theme, but also to their chosen GC theme, which will first be approved by the GCSP Director prior to formal submission of the essay to the University. Suggested Pathway themes include ‘Applied Ethics’, ‘Design Thinking’, ‘Food, Hunger, Poverty & Environment’, ‘Global Health’, ‘Leading People, Organizations & Social Change’, ‘Sustainability’, and ‘Values in Science & Technology’, though any Pathway can be completed with Director approval.
- Participation on a multi-disciplinary design project at the capstone level or other academic year-long sustained participation. Examples of this include our senior design capstone projects as well as significant design project competitions such as Solar Decathlon, Tiny House, and others that have been offered in the recent past.
- Participation in design projects through Hubs or Labs on campus such as the Frugal Innovation Hub, the BioInnovation and Design lab, or the Robotics Systems Lab, or through student organizations such as Engineers Without Borders, Engineering World Health, etc. Design projects completed should ensure significant breadth and depth of experiences. Therefore, a minimum of 6 weeks full-time experience or at least one quarter (10 weeks) of part-time experience is required.
- Successful participation in an explicitly interdisciplinary project-based course or other technical elective (minimum 4 units)
- Double-major or minor in a non-engineering discipline

### **3.4. Social Consciousness**

The purpose of this competency area is to work with the people and organizations that are most strongly affected by the Grand Challenges now and in the future. In addition, a sense of caring and compassion for all people of all classes and abilities is an important attribute of someone who will be designing solutions that affect many different types of people. Each GCSP scholar will participate in a significant service oriented activity which requires the equivalent of at least 30 hours of community service work and which may potentially include:

- Logged community service with reflection essay connecting service to their selected GC theme
- Participating in an approved [Global Engagement Office](#) program including Engineers without Borders or an Immersion Experience
- Completing their senior design capstone project or other research project with a substantial community engagement component
- Participation in projects led by the Frugal Innovation Hub, the Miller Center for Social Entrepreneurship or other Hubs/Labs on campus with significant community engagement component
- Participation in internships for global service organizations

- Completion of coursework in social action which includes our Experiential Learning for Social Justice, Cultures & Ideas, and Ethics core curriculum areas
- Successful completion of other community outreach experiences or coursework

### **3.5. Viable Business/ Entrepreneurship**

The combination of entrepreneurship and innovation is central to promoting growth and technological development in our society. Santa Clara University recognizes the value in engaging students in the process of translating innovation into practical solutions that make a difference in people’s lives through entrepreneurship as it has two related minors offered through the Leavey Business School and the General Engineering program within the School of Engineering. Furthermore, SCU has existing Centers of Distinction including the Miller Center for Social Entrepreneurship and the Center for Innovation and Entrepreneurship. In addition, SCU is a long-time member of the Kern Engineering Entrepreneurial Network (KEEN) with faculty dedicated to the inclusion of entrepreneurial thinking in their offered coursework and design experiences. Finally, SCU often offers hackathons and pitch competitions which feature entrepreneurial themes throughout the academic year.

We will leverage these curricular and extracurricular programs to ensure students understand and display a basic level of achievement in this Grand Challenges competency area. Unless specifically stated otherwise below, significant breadth and depth of experiences for these activities is required to be a minimum of 10-hrs of focused work with a submitted summary reflection of learning gains from each activity and its connection to the scholar’s chosen GC theme. Students are required to complete one of the following:

- Successfully complete a minimum of twelve units from the Entrepreneurship or Technical Innovation, Design Thinking, and Entrepreneurial Mindset minor offered through the Business or Engineering School or other mentor-approved coursework.
- Work/Intern at a start-up or early stage venture that addresses a Grand Challenges Area, minimum of part-time work (5-10 hrs per week) for duration of a 10-week quarter.
- Participate in competitions and/or entrepreneurship events within or outside of SCU.
- Participate in SCU’s Innovation Fellows Program (UIF) leadership circle (via Stanford Epicenter) for one academic year.
- Pursue any other project that displays a substantial level of commitment and initiative on the part of the student to investigate and understand entrepreneurial thinking.

## **4. Funding and Support for the Program**

We are first and foremost leveraging existing programming and design opportunities and experiences already offered at SCU. We believe all of the pieces are already in place to start the GCSP in Fall 2019. We have already begun to develop a website to publicize the program and have selected 2 engineering students to attend ASU’s GCSP Summer

Experience June 2019. These students are excited to attend, learn, then advocate for our new program when they return to SCU! While we still need to identify the faculty who will staff the Steering Committee and who would be interested in serving as faculty mentors, these efforts will likely be identified from faculty currently leading other synergistic programs.

The School of Engineering also has resources within its budget to support the various facets of the program described above, many of which are already built and offered. Thus, we are consciously trying to limit the amount of additional funding required for this program. Of course, it may be likely that the School, GCSP scholars, faculty mentors, and Steering Committee members may require funding to support execution of portions of the GCSP or individual curricular plans. Such items include but are not limited to:

- Travel expenses to GCSP events
- Stipends or course equivalencies or releases for the GCSP Director or faculty mentors
- Logistic support for GCSP meetings (food, drinks, etc)
- Funding for the GCSP scholars to participate in service learning or study abroad experiences

With this in mind, the School may choose to catalyze our GCSP efforts by shifting a few key resources and, at the discretion of the Dean, additional funds may be provided depending on specific events requested by the Director.

Finally, the Portfolium digital roadmap platform that will be used for assessing and submitting scholar's work has already been funded and made available for the entire SCU community through a Convergence Grant awarded to the GCSP Director. The Director will work with every GCSP scholar and faculty mentor to ensure they are trained and comfortable with the platform and its use as part of the SCU GCSP. There are no additional costs expected at this time for this program platform.

## **5. Closing**

The Grand Challenges Scholars Program is well-aligned with SCU and its Jesuit mission, curriculum, and culture of educating the whole person in order to build a more humane, just and sustainable world. The School of Engineering stands ready to launch a GCSP at SCU that will help our students connect the Grand Challenges with their education, their career, their public service, and their lives.

## 6. Appendices

### 6.1. Grand Challenges Scholar Program (GCSP) Application Form

This form is meant to serve as a draft for your GCSP Plan of Study and should be discussed with your faculty mentor or recommender prior to formally submitting to the GCSP Director and Steering Committee.

Student Name: \_\_\_\_\_ Major: \_\_\_\_\_

Faculty Mentor/Recommender: \_\_\_\_\_ Completed Course Units: \_\_\_\_\_

Select the Grand Challenges theme(s) of interest from the following list:

#### **Energy and Environment**

- Make solar energy economical
- Provide energy from fusion
- Develop methods for carbon sequestration
- Manage the nitrogen cycle
- Provide access to clean water

#### **Health**

- Advance health informatics
- Engineer better medicines

#### **Security**

- Prevent nuclear terror
- Secure cyberspace
- Restore urban infrastructure

#### **Learning and Computation**

- Reverse engineer the brain
- Enhance virtual reality
- Advance personalized learning
- Engineer the tools for scientific discovery

*\*Note that you can also select a broader GCSP theme such as 'health', 'sustainability', 'security', or 'joy of living'. These broader themes could be connected to other grand challenges programs such as the U.N. Sustainable Development Goals for the like.*

List one or more potential research projects and explain briefly how they align with your selected Grand Challenges theme(s).

**For each Grand Challenges competency:** Identify which activities, experiences, or coursework you will complete and describe how that experience aligns with your Grand Challenges theme(s).

**Talent:**

**Multidisciplinary:**

**Multicultural:**

**Social Conscious:**

**Viable Business/Entrepreneurship:**

Attach the following documents to your GCSP application:

- ✓ Personal essay (no more than 1 page) on motivation to complete the SCU Grand Challenges Scholar program and the specific challenge you want to address.
- ✓ Recommendations from at least one faculty member/mentor addressing your strengths, talents and motivation for completing the GCSP components.
- ✓ Endorsement from your academic advisor (or department chair) who is in a position to gauge whether admission to this program is recommended based on current GPA and courses to come.
- ✓ A proposed Grand Challenges faculty mentor.
- ✓ A proposed Grand Challenges Plan Schedule (from drafted form above) that outlines how you plan to fulfill each of the five Grand Challenges competency areas as part of their program of study and is feasible to be completed in your remaining time at SCU.

## **6.2. Directive to Grand Challenges Scholars recommenders**

The Grand Challenges Scholars Program gives SCU undergraduates the opportunity to build a coherent and cohesive set of activities during their time at SCU that will distinguish them from other students. Scholars will need to complete activities or courses in five focal areas: Talent, Multidisciplinary, Multicultural, Social Conscious, and Viable Business/Entrepreneurship.

Overall, this letter should address the strengths, talents and motivation of the student that will sustain him/her in completing the GCSP components. Ideally, the recommender will have first hand knowledge of the applicant's work habits, persistence, organizational abilities, and independence, all essential to identifying and completing activities to fulfill GCSP requirements. Therefore, as an identified recommender, we would appreciate your addressing some of the following areas as we believe these are essential to the successful completion of this program.

- To what extent is s/he persistent, organized, reliable, or independent? Can you give an example?
- What characteristics have you seen that lead you to believe s/he will seek out and complete the required program components?
- To what extent does s/he have a passion for and a desire to solve an aspect of a global Grand Challenge?

### 6.3. **Grand Challenges Scholar Program (GCSP) ePortfolio Guide**

Each Grand Challenges Scholar Program (GCSP) scholar must work with their faculty mentor and the GCSP Director to complete an electronic portfolio (ePortfolio) providing evidence of satisfactory achievement of the five GCSP competencies: Talent, Multidisciplinary, Multicultural, Social Conscious, and Viable Business/Entrepreneurship. Students must submit an ePortfolio update every spring and upon completion of the program to the GCSP Director and the Steering Committee for approval. All ePortfolios must contain the following elements:

- Welcome/Home page
  - Include your name and major, the University name, selected GCSP theme, name of your faculty mentor, and a general welcome to your ePortfolio.
- One page for each of the five GCSP competencies - for each page briefly summarize the competency, how you chose to fulfill this (method/procedure), and evidence of fulfillment/completion. Examples of evidence you may choose to include are:
  - For research, you may choose to include a research report which describes your project objective(s), methodology and outcomes. At a minimum, your report must include the following sections: Introduction and Background, Methodology, Results, Discussion, Conclusions, Future Recommendations, and References
  - For courses, include a syllabus and example course materials that illustrate how your learning experience relates to your GCSP theme and to your competency area
  - For projects/activities, provide evidence of what you have learned through your experiences and show how this experience relates to your GCSP theme. This is a great opportunity for visuals!
- Overall GCSP outcome evaluation - Reflect on your overall GCSP experience. Discuss how your various learning experiences help you achieve the GCSP goals in each of the five components. Cite specific examples and evidence included in your ePortfolio demonstrating your achievement of the GCSP goals. Discuss the connectivity across the five components addressing your Grand Challenges theme. Note any components not well achieved by your experience in the GCSP. State your overall opinion of your GCSP experience and how the GCSP could be improved.