WEST VIRGINIA UNIVERSITY
BENJAMIN M. STATLER COLLEGE OF ENGINEERING AND MINERAL RESOURCES

NATIONAL ACADEMY OF ENGINEERING GRAND CHALLENGE SCHOLARS PROGRAM PROPOSAL

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Vision and Goals

Describe the vision and goals for your GCSP program with an explanation of how they fit with the institutional and contextual values and mission.

As a land-grant institution in the 21st century, West Virginia University’s mission is to deliver high-quality education, excel in discovery and innovation, model a culture of diversity and inclusion, promote health and vitality, and build pathways for the exchange of knowledge and opportunity between the state, the nation, and the world.

The mission of the Statler College of Engineering and Mineral Resources is to prepare students for success in their professional careers; to contribute to the advancement of society through learning, discovery, extension, and service; and to stimulate economic well-being in West Virginia and the world through technical innovation, knowledge creation, and educational excellence.

We visualize the Mountaineer Grand Challenge Scholars Program (M-GCSP) at West Virginia University as a framework for providing students with unique educational opportunities and experiences that will be professionally rewarding and contribute to the mission of WVU, the Statler College of Engineering and Mineral Resources, and the National Academy of Engineering Grand Challenges.

Vision statement: Mountaineer Grand Challenge Scholars will be sought for their demonstrated ability to identify significant opportunities and bring their solutions to reality, recognizing the societal and global impacts of the issues and working effectively in a wide variety of settings with many different people.

Goals:

- Enroll 10 GCSP scholars during 2017-18
- Graduate 20 GCSP scholars per year by 2020
- Leverage the GCSP to increase our percentage of Statler students going abroad for studies, research, or service to 20% of the graduating class by 2020
- Leverage the GCSP to create 10 new companies in West Virginia by 2020

Steering Committee

Describe the recruitment and selection of the membership of your steering committee and their responsibilities

Recruitment and selection of membership for the Mountaineer GCSP may include University and College administrators, faculty, students, and possibly select external constituents. We envision the Mountaineer GCSP steering committee will be comprised of five (5) members selected for their oversight and involvement in existing University programs that will contribute and compliment the educational components of the Mountaineer GCSP experience.
The Statler College Associate Dean for Academic Affairs (David Wyrick) will serve as the program director. The program director’s office has responsibility to manage the day-to-day activities of the program. This includes such things as:

- Recruitment of students into the program
- Outreach to the university, community, industry, and international university partners
- Evaluation of application materials and selection of participants
- Approval of student curricular plan
- Communication with the student’s mentor and evaluation of student academic progress
- Along with faculty mentor, assess student learning outcomes and certify that students have successfully completed the educational requirements of the Mountaineer GCSP
- Monitor and document accomplishments of program participants while in residence at WVU and up to five years after graduation
- Assess and evaluate student outcomes to provide continuous quality improvement of GC Scholars academic experiences
- Prepare an annual report documenting program activities and accomplishments
- Attend GC workshops and summits

Members of the steering committee will be:

- One faculty or administrative representative who will be recruited from WVU Honor’s College, the Center for Service Learning, WVU Launch Lab, Office of the AVP for Entrepreneurship and Innovation, or the WVU Extension Service. Terms will be for three years, and will be selected by the Dean of the Statler College.
- Two faculty or administrative mentors from the Statler College of Engineering and Mineral Resources, Eberly College of Arts and Sciences, or Davis College of Agriculture, Natural Resources, and Design. Terms will be for three years, and will be selected by the Dean of the Statler College.
- One Mountaineer GCSP student in their final year of study or a student organization leader (e.g., from EWB, SWE, or Tau Beta Pi). The student will serve for one year, and will be selected by the Dean of the Statler College.
- One external member from industry and/or government. Terms will be for three years, and will be selected by the Dean of the Statler College.

The responsibilities of the steering committee will be to advise the program director. The Steering Committee will:

- Review program activity and student/mentor experiences
- Provide program oversight, feedback, and advice to the Mountaineer GCSP director
- Assist the program director with preparing the annual report for the GC Scholars Program
- Periodically review that students are meeting program objectives and if necessary, revise/update program objectives. (The student member of the Steering Committee will not be involved in this evaluation.)
- Work to provide continuous quality improvement of the educational experience provided by the program
- Assist with marketing and publicity of the program
- Assist with recruiting students and faculty
- Recommend applicants to be selected Mountaineer Grand Challenge Scholars

We anticipate the steering committee meeting twice during an academic year (fall and spring).
Recruiting

Describe your plans for recruiting GCSP students. Need to select a diverse cohort of engineering and non-engineering students.

The Mountaineer GCSP will be promoted to both future and current students. We will promote the program to prospective students through the Statler College’s existing student outreach and recruitment efforts of high school visitation events, engineering and science summer camps, summer undergraduate research programs, web links, etc. The program will also be promoted through the WVU Honor’s College and Statler College student organizations and professional societies, the College’s home page, and the College’s Fundamentals of Engineering Program (FEP) which serves all first-time freshmen students before they are admitted to a specific engineering major. The FEP requires freshmen to attend multiple out-of-class events during the year, several of which will discuss the Grand Challenges and promote the Mountaineer GCSP.

Other avenues of promotional outreach and recruitment include the many projects/activities led and/or managed by engineering and computer science students in the Statler College or students in other programs at WVU, particularly in the Eberly College of Arts and Sciences and the Davis College of Agriculture, Natural resources, and Design. Examples include the Eco-Car Challenge (http://ecocar.wvu.edu/), Engineers Without Borders (http://ewb.orgs.wvu.edu/home), WVU Launch Lab (http://launch.wvu.edu/home); the West Virginia Collegiate Business Plan Competition through the College of Business and Economics (http://www.be.wvu.edu/bpc/); the West Virginia Technology Entrepreneurship Challenge through the Davis College of Agriculture, Natural Resources and Design (http://wvtec.davis.wvu.edu/), and the WVU Summer Undergraduate Research Experience (http://undergraduateresearch.wvu.edu/summer-undergraduate-research-experience).

Organizations like NSBE, SHPE, and SWE will receive focused information on the Mountaineer GCSP. Information will also be shared with the Eberly College of Arts and Sciences, the College of Business and Economics, and the Davis College of Agriculture, Natural Resources and Design to recruit interested students and to promote the program.

Application and Selection

Describe your application and selection process for GCSP students, including how students will be mentored, if necessary, through this process, approximately how many students you anticipate admitting each year and the characteristics of those students, such as majors and whether first-year students can apply. Include the ways in which your recruitment processes are consistent with the institutional and contextual values as well as the goals and vision for the program and its diversity. Note that some institutions establish minimum GPA’s for participating students while others do not in order to increase the odds of securing a diverse cohort. We encourage programs to aim for the goal of producing 20 GCSP graduate per year, as outlined in the White House pledge (although such a goal may not be practical for smaller institutions and as such should not be viewed as an absolute requirement, but rather a goal for those programs who can reasonably achieve it).

Students will be introduced and recruited to apply to the Mountaineer GCSP beginning in their freshman year. Students may be admitted in their freshman, sophomore, or junior years of their curriculum. Transfer students and second degree students will be introduced the program during their first year in Statler College. Students will need to be in residence at the University
for at least three semesters (approved study abroad will be considered in residence). While the M-GCSP is originally intended for engineering, computer science, and other STEM students, we will consider students from other majors as well.

Students will be invited to attend an informational session hosted by the College during the fall and spring semesters of each academic year. Informational sessions will introduce the Grand Challenges and the Mountaineer GCSP, review the application process, introduce them to mentors, and provide overviews of projects and experiences of current senior students in the program. The application form will be available on the college’s website.

All students in good academic standing at WVU and their academic program with a minimum GPA of 2.50 will be eligible to apply (in the major and overall WVU). The application package will include:

- Student essay of why they want to participate, the Grand Challenge they intend to address, the relation of the challenge to their major field of study, and how they intend to integrate the global component
- A plan of study indicating how curricular requirements of the GCSP will be met
- A letter of commitment from student’s mentor
- A current unofficial transcript

We anticipate accepting up to 30 students into the program annually to start each fall academic semester. We anticipate that our first class of scholars will be selected by the end of the Fall 2017 term; following groups of scholars will be selected in the spring of each year.

Each student admitted to the program may apply for a one-time educational enhancement award of up to $1,000. This award, with the program director’s and GC mentor’s approval, can be used for:

- Travel support for study, research, or internship abroad that is integrated into the GCSP
- Support to participate in other specific GC-related student activities;
- Research support on their grand challenge topic

The Mountaineer GCSP Director will convene the Steering Committee during the Spring semester to review applications to the program. The Steering Committee will provide their recommendations to the GCSP Director for final vetting and selection. Students will be notified of their selection in early March so that they can make timely course registration for the Fall semester. (The initial group of grand challenge scholars will apply in the fall of 2017 and be selected by November 2017.) The selection committee will include faculty GC mentors and may include advanced student scholars in the program.

Students accepted into the Mountaineer GCSP will need to maintain eligibility to remain in the program. To remain eligible, Mountaineer GCSP scholars will need to:

- Maintain good academic standing (overall WVU and major GPA of at least 2.50)
- Maintain satisfactory academic progress
- Meet at least once each semester with their faculty GC mentor
- Provide written progress updates, by September 15, of the past academic year’s accomplishments and activities and their plans for the next academic year
- Complete the Engineering Grand Challenges minor requirements by the time of graduation

During the last semester of their program scholars will need to:

- Enroll in a 1-credit GCSP Capstone Course
• Prepare a final self-assessment and reflective report on their educational experience and submit it by March 15 to their mentor, the capstone instructor, and the program director
• Present their research project or senior capstone design project at local, regional or national venues (e.g., West Virginia Research Day at the Capital, WVU Undergraduate Research Day, the Statler College Senior Capstone presentations, or other appropriate venue)

The final self-assessment and reflective report will describe:
• How the requirements of each of the five GC areas were met and completed
• Overall focus of the scholar’s research work
• Breadth and depth of their program,
• Comparison of their overall experience to their initial application essay, and
• Note program highlights and/or lacking program elements that would strengthen the overall educational experience offered by the program.

Faculty Mentors

Describe how you will recruit, educate, support, and assign faculty mentors for your GCSP students. Include specific responsibilities that your mentors must commit to.

Faculty mentors will be recruited from the Statler, Eberly, and Davis Colleges, as well as the WVU Health Sciences Center. These faculty members should be recognized as outstanding advisors/mentors and who embrace the need for 21st century engineers, scientists, and citizens to have an appreciation for inter/intra disciplinary educational experiences that expose them to global and societal issues of different cultures and people groups. A faculty mentor is encouraged, but is not required, to oversee the student’s research experience. Faculty members may apply to become mentors from any WVU department, with approval of their department chair and the M-GCSP Steering Committee.

Faculty mentors in the Statler College will receive a $200 enhancement award for each student they contract to mentor, and will receive an additional $300 enhancement award when the student has successfully completed the Mountaineer GCSP and graduates. Enhancements can be used for travel, conference registration, training, etc.

The faculty mentor must commit to:
• Meet individually with their student(s) at least once each semester
• Review and develop, with their student, a curricular path for meeting the educational expectations of the Mountaineer GCSP
• Review the scholar’s progress updates, by September 15, of the past academic year’s accomplishments and activities, and engage the scholar with their plans for the current academic year
• Review the scholar’s final self-assessment, reflective report by April 15th, and forward to the capstone instructor and program director
• Help the scholar think through and prepare their plans for the coming academic terms and year
• Help the scholar prepare and present their research project or senior capstone design project, and GCSP capstone project report
• Assess achievement of program student learning outcomes
• Verify the completion of the scholar’s plan
• Prepare a letter of recommendation outlining satisfactory completion of the program requirements by their scholar to the Program Director
Funding/Support

*Attend the College’s information sessions to meet prospective GCSP scholars*

*Funding/Support*

*Describe how your program will be funded and supported. Note that there is no specific funding level required but if you plan for students to study abroad, travel to national GCSP events, engage in research or service or entrepreneurship activities which require funding; if you plan to schedule on-campus events for your students; if you plan for your director and/or dean to participate in national GCSP events, etc., please indicate how these efforts will be funded/supported. Potential funding needs could include:*

Funding for the Mountaineer GCSP will be budgeted from a GCSP sub-account. Revenue from the Charles Vest Fund, the Statler College Endowment, and college tuition and fees will be used to cover this sub-account. We will seek to increase the size of this subaccount through additional development activities to allow the program to grow over time. The annual expenses are estimated to be:

- Travel expenses for the GCSP Director and perhaps 1-2 faculty and 2-3 students to attend a national GCSP event each year. $12,000
- Faculty mentor enhancement awards (30 applicants/year, 30 graduates/yr) $15,000
- Course release or stipend for the Steering Committee Chair (or 1 month of summer salary) $12,000
- Food costs for GCSP meetings and events. $1,000
- Guest speaker travel expenses and honoraria. $4,000
- Funds for Mountaineer Grand Challenge Scholars to enable:
  - Travel support for approved study, research, or internship abroad that is integrated into the M-GCSP, or $30,000
  - Support to participate in other GC-related student activities, or
  - Research support (30 awards/yr of $1,000)
- Printing and marketing expenses to promote and support the GCSP. $1,000
- TOTAL ANNUAL SUPPORT $75,000

Unique Aspects

*Describe any unique aspects of your program that allow for understanding of the context in which your program is designed and implemented. For example, will students receive scholarships? Will they participate in an on-campus program such as honors, student ambassador or other special program? In order for students to complete one or more aspects of your program, will you be partnering with EPICS, Engineers Without Borders, University Innovation Fellows, Habitat for Humanity, senior design, freshman engineering, study abroad, service learning, tutoring, or other local organizations or programs? Do you plan to target non-honors students, honors students or some other specific groups?*

The Mountaineer GCSP will encourage students to pursue special opportunities abroad, entrepreneurial activities, and/or research opportunities through a special educational enhancement award of up to $1,000 during the course of their program. This award, subject to
the approval of their faculty mentor and the program director, could be used to offset travel costs for studying abroad, a stipend and materials for research, travel to conferences, or other justifiable expenses related to their grand challenge program.

We will strongly encourage students to integrate a meaningful study abroad experience into their program. We work closely with our Office of International Studies. During the 2017-18 academic year, the program director will work with each undergraduate program in the Statler College to identify one international partner university with a curriculum that allows students to take a full course load that will apply toward their degrees, obtain MOUs, in time to allow students to easily study abroad in 2018-19.

For students who cannot study abroad, we will allow other appropriate cultural studies so they can gain an appreciation of the diversity of cultures within the United States.

WVU has an interdisciplinary Launch Lab that is open to all students. Launch Lab helps students develop a hands-on entrepreneurial mindset, offers prototyping and 3D printing capabilities, and provides access to the business functions that can be used to launch new enterprises. The Launch Lab and the entrepreneurial engineering courses will play a key part in the Mountaineer GCSP.

Another unique element of this program is that students who complete it will also receive a minor in Engineering Grand Challenges. The Engineering Grand Challenges minor is being prepared for proposal to be implemented in the fall of 2018. While any student at WVU may complete the minor, students must apply to the Mountaineer Grand Challenge Scholars Program. (The proposed catalog entry is included in the appendix.)

Grand Challenges Scholars Program Components

Describe the specific activities, curricular and/or extra-curricular, which your students must fulfill in order to satisfy each of the five components of your program, below. (You may want to provide 2-3 options of similar complexity for each component OR you may want to identify low, medium and high level activities for each component with an overall minimum number of high level and maximum number of low level activities OR you may elect to utilize some other structure).

The Mountaineer GCSP is initially designed to include an academic minor of 16 credits. The five components will be contained within the minor, as well as a 1-credit GCSP Capstone Experience. WVU students seeking the Engineering Grand Challenges minor need only to complete the five courses and capstone (as described in the proposed minor curriculum in the appendix).
Students who wish to complete the Mountaineer Grand Challenge Scholars Program must take courses to satisfy the academic components for the Engineering Grand Challenges minor and complete approved experiential learning in at least two of the five components to satisfy the Mountaineer GCSP program. Please note that the GCSP Capstone is in addition to any required capstone design course(s) required by the student’s major.

It is important that the student’s application, annual report, and capstone project summary capture the key elements (academics and experiential learning) from each component are appropriate to the student’s selected grand challenge and that they provide sufficient exposure. This is one of the benefits of engagement that will be provided by the faculty mentor.

**Interdisciplinary Component**

Bridging engineering to other disciplines is essential for solving the NAE Grand Challenges. An “Engineering-Plus” curriculum should be devised to prepare students to work at the boundary between engineering and non-engineering disciplines, such as public policy, international relations, business, law, ethics, human behavior, risk, medicine, the natural sciences, etc. However, this must be more than simply double majoring or picking up a minor in a non-engineering discipline. Specifically, each GCSP should have an institutionally tailored mechanism that thematically draws together the engineering and non-engineering curricular components of each student’s course of study. Examples: an explicitly interdisciplinary course or a GCSP seminar series. Each Scholar’s work should be reviewed and approved as being sufficiently broad and related to one or more of the Grand Challenges.

The academic requirement of the interdisciplinary component can be met with any course specified in “Category 1” of the Engineering Grand Challenges minor.

If a student wishes to satisfy the experiential learning requirement in the interdisciplinary component, the following experiences may be proposed to the mentor for review by the Steering Committee (the student may propose other experiences for consideration). An experience selected to satisfy experiential learning in this component may not be used to satisfy any other component.

- Business Plan competition
- Student projects
  - Eco Car
  - Design/Build/Fly
  - Robotic Competitions
  - Microgravity team
- Student government
- Approved student interdisciplinary experience proposal

**Research Component**

Project or research activity engaging a GC theme or challenge: Working to solve the NAE Grand Challenges is the motivation for the GCSP. Each GC scholar must participate in a substantial team or independent project relating to a Grand Challenge theme or specific Grand Challenge problem. Examples: formal undergraduate research programs, senior theses, graduation with distinction, on-site internships, or capstone design projects.
The academic requirement of the research component can be met with any course specified in "Category 2" of the Engineering Grand Challenges minor.

If a student wishes to satisfy the experiential learning requirement in the research component, the following experiences may be proposed to the mentor for review by the Steering Committee (the student may propose other experiences for consideration). An experience selected to satisfy experiential learning in this component may not be used to satisfy any other component.

- Summer undergraduate research experience (SURE) or other undergraduate research experiences with faculty focusing on
  - Energy and the environment
  - Bioengineering
  - Security – biometrics and cyber security
- Research experiences at partner universities
- Internships
- Student competition projects
  - Solar house
  - EcoCar
  - NASA Challenges
- Approved student research experience proposal

Entrepreneurship Component

Implementing innovation is central to technology development. Each GC scholar must participate in a curricular or extra-curricular component that involves the process of translating invention and innovation into market ventures. This may be either risk-taking ventures for business or introducing technology for not-for-profits in the public interest. Examples: submitting an invention disclosure, participating in start-up competitions, campus or community engagement, and/or formal classes in marketing, patent law, intellectual property, etc.

The academic requirement of the entrepreneurship component can be met with any course specified in "Category 3" of the Engineering Grand Challenges minor.

If a student wishes to satisfy the experiential learning requirement in the entrepreneurship component, the following experiences may be proposed to the mentor for review by the Steering Committee (the student may propose other experiences for consideration). An experience selected to satisfy experiential learning in this component may not be used to satisfy any other component.

- Projects with small and medium enterprises around the state in conjunction with the Manufacturing Extension Partnership project office at WVU
- Work with the WVU Launch Lab
- Sponsored business plan competitions
- Approved student entrepreneurship experience proposal

Global Component

Global awareness is necessary for working effectively in an interdependent world. Students may participate in a curricular or extra-curricular component that instills elements necessary to develop innovations in a global economy, or address ethical
issues of global concern. While studying abroad is an ideal mechanism, domestic activities that stress global or cross-cultural implications may satisfy this component. Examples: completing formal classes, participating in internships that emphasize global nature of engineering work, or conducting research in global health, global environmental challenges and/or internships abroad, etc.

The academic requirement of the global component can be met with any course specified in “Category 4” of the Engineering Grand Challenges minor.

If a student wishes to satisfy the experiential learning requirement in the global component, the following experiences may be proposed to the mentor for review by the Steering Committee (the student may propose other experiences for consideration). An experience selected to satisfy experiential learning in this component may not be used to satisfy any other component. Note that a study abroad experience of at least four weeks may be approved for both academic and experiential learning requirements.

- WVU Faculty-led study abroad courses (including Mechanical and Aerospace Engineering’s Summer Senior Design in Mexico, a spring trip to Germany to study German engineering, and a summer service learning course where students to teach engineering to K-12 students at camps in Jamaica)
- Study abroad/student exchange with international universities
- Study abroad experiences with designated service providers like CEPA
- Global Competencies Certificate program
- Engineering Without Borders service projects
- Work in a lab in another country
- Select internships with firms that have significant international dealings (e.g., supply chain management or distributed design)
- Approved student global experience proposal

Service Learning Component

Working for the benefit of others is the foundation of a civil society. Students may participate in a curricular or extra-curricular component that deepens their social awareness and heightens their motivation to bring their technical expertise to bear on societal problems. Examples: completing formal classes in social action, participating in internships for global service organizations such as Engineering World Health or Engineering without Borders, or curricular service learning experiences like Engineering Projects in Community Service (EPICS), conducting research in an area with a clear component of improving the human condition, or participation in an institution’s community service or tutoring program. Do note that service learning differs from service projects in that it focuses on intentional learning as the primary goal. Service learning also includes a crucial reflection piece, which includes reflective writing on topics such as what did you learn, does the group need further assistance, should you have chosen a different task to be more successful and a discussion of your own personal growth and understanding of the situation due to the project.

The academic requirement of the service learning component can be met with any course specified in “Category 5” of the Engineering Grand Challenges minor.
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If a student wishes to satisfy the experiential learning requirement in the service learning component, the following experiences may be proposed to the mentor for review by the Steering Committee (the student may propose other experiences for consideration). An experience selected to satisfy experiential learning in this component may not be used to satisfy any other component.

- The College's Jamaica summer service learning course (students have prepared engineering activities to teach to K-12 students in summer camps; and designed systems for providing clean water)
- Projects with small and medium enterprises around the state in conjunction with the Manufacturing Extension Partnership project office at WVU
- Projects coordinated by the WVU Center for Service and Learning
- Tau Beta Pi service projects
- Engineers Without Borders (student organizations in general do these types of activities)
- Research (integrating research projects into societal needs, such as when researchers and students studied and helped with chemical spills in Charleston, and with historical building reconstruction/rejuvenation after fires in Harpers Ferry)
- Use of the extension service to identify community level service projects in counties of the state
- Approved student service learning experience proposal

Provide a summary document (½ to 1 page) that shows the options, above, students have for completing the five components of your program. It may be useful to include a schematic or a diagram for that describes an example of how a student in your program may satisfy all of the requirements.

Please see the examples provided in the appendix.

Mentorship, Support, Tracking and Assessment

Describe how students will be mentored and supported throughout the program, include the ways in which their progress will be tracked and assessed for completion of your program requirements.

The Mountaineer GCSP program will be managed through the office of the Associate Dean for Academic Affairs of the Statler College. All paperwork (electronic) is maintained through the Office of Student Services. The GCSP minor can be tracked through the Degree Works student advising system by students, advisors, and administration. A curriculum proposal for the GCSP minor will be prepared for approval, which is necessary before the minor can be input into Degree Works.

Mentors will be recruited from the faculty in the college. They are expected to meet with their scholars at least once each semester, provide advice and direction, and meet the other expectations described earlier. Mentors will receive "credit" for promotion and tenure considerations at the time the scholars successfully complete the GCSP and graduate.
Students are required to prepare a reflective summary of their program, its originally intended goals, the results of their program, and a critical analysis of their contributions and what improvements or changes they would have made.

Surveys will be used to collect data and opinions of the students (and mentors) of the value and efficacy of the student’s experience each semester, in addition to the summary reflection report. This will enable how each individual component option performs as well as the program overall. From an evaluation of the surveys and reports, the components selection may be refined and the program improved.

Recognition

Describe how graduates of your program will be recognized by your institution. (Your director will be required to report all graduates of your program each May to the national GCSP steering committee. Your students will be included in the national press release, as well as receive a letter from the NAE President. You may elect to recognize them in additional ways).

Students accepted into the Mountaineer GCSP will be designated as Grand Challenge Scholars. Successful completion of the program will result in the student earning a minor in “Engineering Grand Challenges”. This minor designation will be placed on the student’s official University transcript. GCSP scholars will be specially noted in the Statler College's annual Honors Day, which is attended by many parents and other guests.

Other

Describe any other aspect of your program not included above.

In the future, it may be possible to develop an interdisciplinary Bachelor of Science in Engineering (BSE) major that allows students to design a specific program that focuses on the grand challenges rather than on a traditional engineering discipline. This major is envisioned to be fundamentally strong in the core engineering sciences and mathematics, with an appropriate foundation in science for the selected grand challenge and an appropriate level of computer science. This program would be accreditable under the Engineering Accreditation Commission of ABET.
Examples of the Minor in Mountaineer Grand Challenge Scholars Program

Example 1. Mechanical Engineering Major ("ME"). Making solar energy affordable grand challenge

Component 1. The Interdisciplinary Component can be satisfied by taking a 3-credit course in the Davis College on sustainable design. (DSGN 280, Sustainable Design and Development. An overview of social, environmental and economic aspects of the built environment. Site considerations, infrastructure, green buildings, marketing, financing, community. [Local field trips possible.]) ME learns about sustainability from a non-engineering perspective, including the political and societal concerns that need to be addressed. The student takes this in the sophomore year.

Component 2. Research Component can be satisfied by a summer internship with Brookhaven National Lab’s solar farm on Long Island after the junior year. ME’s project addresses maintainability issues related to salt deposits from the nearby ocean on the solar collectors. ME prepares a summary report of the experience for the mentor and program director. ME realizes the need to better understand variability of systems and takes Intermediate Statistical Methods (STAT 312).

Component 3. The Entrepreneurial Component can be satisfied by taking the 3-credit Engineering Entrepreneurship (ENGR 450, currently in the process of approval through the CIM course inventory management system). The experiential class allows the student to identify opportunities, design solutions, manufacture prototypes, and develop the business case for a new venture. ME develops a small personal solar battery charger for mobile phones while taking this class in the senior year.

Component 4. The Global Component can be satisfied by taking the 6-credit capstone design course in the faculty-led summer course in Querétaro, Mexico. ME works in a team with students from universities in Mexico, Argentina, and Nevada to improve the manufacturability of solar panels for a large multinational company with manufacturing facilities in southern Mexico. ME takes this after the fourth year.

Component 5. The Service Learning Component can be satisfied by working with Engineers Without Borders to deliver a sustainable clean water system to a village in Honduras as a junior. ME prepares a summary report of the experience for the mentor and program director. To meet the academic requirement for Component 5, ME enrolls in AFCS 499 Global Service Learning and meets the service obligations in conjunction with the summer experience in Querétaro.

During the last semester, ME completes a comprehensive capstone project report on the Grand Challenges experience and presents it at the University’s Research Day.
Example 2. Computer Science Major ("Cosi"), Secure Cyber Space grand challenge

Component 1. The Interdisciplinary Component can be satisfied by participating in the Solar Decathlon project. Cosi works with students from WVU in engineering, business, and design, along with exchange students from the University of Rome Tor Vergata to design and build an efficient, affordable, attractive, and technologically cool home in an international competition. Cosi is involved in two houses over three years. Cosi satisfies the academic component by taking ID 110 Introduction to Interior Design.

Component 2. The Research Component can be satisfied by the CS 480-481 capstone design project for 5 credits. Cosi works on a secure communications protocol with a sponsor at the NASA facility in Fairmont, WV.

Component 3. The Entrepreneurial Component can be satisfied by working with the WVU Launch Lab to develop an app for mobile phones and starts a company as a sophomore. Cosi takes an online course in technology entrepreneurship (IENG 474).

Component 4. The Global Component can be satisfied by studying abroad at a partner university. During one semester in the junior year, Cosi goes to Al Akhawayn University in Ifrane, Morocco, and takes 15 credits of courses in computer architecture, algorithm analysis, computer communications, introductory Arabic, and engineering economics. (Study at AUI is facilitated by Associate Dean Wyrick's connection as previous Dean of the School of Science and Engineering.)

Component 5. The Service Learning Component can be satisfied by working with the WVU Extension Service. Cosi volunteers to work with WVU Extension on a project in Summers County in the economically-stressed southern part of the state. In addition, Cosi provided hours of structured community service in Morocco while attending AUI, with a focus on developing opportunities for the rug-making cooperative to more broadly market their products.

Although courses have been taken in just four of the five components, Cosi has completed a total of 20 credits of academic work. Cosi requests that the service component be satisfied with experience. This meets the requirements of the GCSP minor.
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Engineering Grand Challenges Minor
[For 2018-19 WVU Catalog]

This minor is open to students who want to address one or more of the 14 grand challenges of the 21st century, as identified by the National Academy of Engineers. These challenges encompass increasing sustainability, improving health, reducing vulnerability, and enhancing the joy of life.

Students may design a minor of five courses from select areas, plus a capstone project, to address one of the following challenges:

1. Make solar energy affordable
2. Provide energy from fusion
3. Develop carbon sequestration methods
4. Manage the nitrogen cycle
5. Provide access to clean water
6. Restore and improve urban infrastructure
7. Advance health informatics
8. Engineer better medicines
9. Reverse-engineer the brain
10. Prevent nuclear terror
11. Secure cyberspace
12. Enhance virtual reality
13. Advance personalized learning
14. Engineer the tools for scientific discovery

Students who intend to complete the minor may apply to be noted as a Grand Challenge Scholar through the Statler College’s Office of the Associate Dean for Academic Affairs. The Grand Challenge Scholars Program is coordinated separately by the Statler College and requires additional experiential learning, special mentoring, a separate GPA requirement, and an application packet to be submitted prior to completion of 50% of the minor. The Grand Challenge Scholars Program may provide supplemental funding for research and education abroad, and special recognition upon graduation.

All courses in the Grand Challenges minor must be completed with a minimum grade of C-. No more than six credits may be used toward another major or minor degree program. At least 10 credits must be at the 300 or 400 level. Courses must be from the following categories and selected to help prepare the student to address one specific grand challenge.

**Category 1: Interdisciplinary Elective**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>ADV 201. Advertising and Society (3)</td>
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<td>AGEE 434. Managing Learning Environment (3)</td>
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<tr>
<td>ARE 201 Principles of Resource and Energy (3)</td>
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<td>ARE 220. Introductory Environmental and Resource Economics (3)</td>
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<tr>
<td>BIOL 105 and 106. Environmental Biology (3) and Lab (1)</td>
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<td>BIOL 107. Biotechnology and society (3)</td>
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<td>BIOL 124. The Human Environment (3)</td>
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<td>BMEG 201. Introduction to Biomedical Engineering (3)</td>
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<td>BUSA 320. Survey of Management (3)</td>
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<td>CHEM 112. Survey of Chemistry (4)</td>
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<td>CHEM 116. Fundamentals of Chemistry (4)</td>
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<td>CDFS 110. Families Across the Life Span (3)</td>
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COMM 112. Small Group Communication (3)
COUN 230. Life Choices (3)
DSGN 140. Sustainable Living (3)
DSGN 280. Sustainable Design and Development (3)
DSM 130. Introduction to Design (3)
ENGR 210. Engineering Decision Making (2)
ENGR 310. Energy Engineering (3)
ENVP 155. Elements of Environmental Protection (3)
FDST 200. Food Science and Technology (3)
GEOG 107 and 106 Physical Geography (3) and Lab (1)
GEOG 110 and 111. Environmental Geoscience (3) and Lab (1)
GEOG 150 and 149. Digital Earth (3) and Lab (1)
GEOL 110 and 111. Environmental Geoscience (3) and Lab (1)
GERO 212. Introduction to Gerontology (3)
History (HIST) course at the 100 level (3)
HONR 215. Confronting Pseudoscience (3)
HUM 101. Introduction to Western Civilization I (3)
HUM 102. Introduction to Western Civilization 2 (3)
HUM 107. The Humanities of Egypt (3)
ID 110. Introduction to Interior Design (3)
LARC 229. Landscape Architecture (3)
LDR 201. Principles of Leadership (3)
NAS 200. Introduction: Native American Studies (3)
PHIL 120. Introduction to Ethics (3)
PHIL 170. Introduction to Critical Reasoning (3)
PHIL 310. Philosophy of Science (3)
PHYS 102 Introductory Physics (4)
PHYS 111. General Physics (4)
POLS 101. Introduction to Political Science (3)
POLS 102. Introduction to American Government (3)
POLS 103. Global Political Issues (3)
PSYC 101. Introduction to Psychology (3)
PR 215. Introduction to Public Relations (3)
RPTR 142. Introduction to Recreation, Parks and Tourism (2)
RPTR 239. Sustainable Tourism Development (3)
RELG 105. Introduction to Issues in Religious Studies (3)
RESM 140. Sustainable Living (3)
SOWK 147. Human Diversity (3)
SOCA 101. Introduction to Sociology (3)
SOCA 105. Introduction to Anthropology (3)
SOCA 207. Social Problems in Contemporary America (3)
WMAN 150. Principles of Conservation Ecology (3)
WMAN 160. Ecology of Invading Species (3)
WGST 170. Introduction to Women’s and Gender Studies (3)
WDSC 100. Forest Resources in United States History (3)

**Category 2: Research Elective**

ADV 409 Advertising Research and Media (3)
ARHS 401. Senior Project-Capstone (1-15)
BIOL 376. Research Methods (3)
BIOL 386. Undergraduate Research (1-4)
BMEG 455. Biomedical Senior Design 1 (4)
BIOM 481. Senior Design Project (3)
CHE 456. Chemical Process Design 2 (3)
CHEM 376 Research Methods (4)
CDFS 250. Research Methods and Data Analysis (3)
CE 479. Integrated Civil Engineering Design-Capstone (3)
COMM 201. Communication Theory and Research 2 (3)
CPE 481. Senior Design Project (3)
CS 481. Senior Project (3)
EE 481. Senior Design Project (3)
EXPH 470. Research Methods (3)
HIST 484. Historical Research-Capstone (3)
IENG 472. Design of Productive Systems 2 (3)
ULIB 200. Research for Non-Profits (3)
MAE Capstone Design (3)
MINE 484 Mine Design-report Capstone (4)
MDS 389. Interdisciplinary Research Methods (3)
NSG 465. Foundations of Research and Evidence Based Practice (3)
OTH 360. Research Methods in Occupational Therapy (3)
PNGE 480. Petroleum Engineering Design (3)
POLS 487. Capstone: Senior Paper (3)
PSYC 202. Research Methods in Psychology (3)
PSYC 204. Research Methods & Analysis 2 (3)

3 cr
SOWK 360. Social Work Research and Statistics (3)
SOCA 311. Social Research Methods (3)
SOCA 356. Ethnographic Field Methods (1-6)
SOCA 357. Archeological Field School (3)
STAT 312. Intermediate Statistical Methods (3)
STAT 331. Sampling Methods (3)

**Category 3:** Entrepreneurship and Innovation Elective  
3 cr
ARE 421. Rural Enterprise Development (3)
ART 380. Art and Environment (3)
BCOR 460. Contemporary Business Strategy (3)
DSGN 480. Designing Innovative Futures (3)
ENGR 450. Technology Entrepreneurship and Enterprise Development (3)
ENTR 300. Creativity and Idea Generation (3)
ENTR 415. Entrepreneurship in Action (3)
FDM 261. Fashion Management Workshop (3)
HRMG 470. Conflict Management (3)
IENG 474. Technology Entrepreneurship (3)
ID 330. Design for Quality of Living (3)
NSG 373. Leadership in Organizations (3)

**Category 4:** Global Awareness Elective
3 cr
ASP 220. Introduction to Africana Studies (3)
AFCS 499. Global Service Learning (1-3)
ART, ARHS 499. Global Service Learning (1-3)
ARHS 101. Landmarks of World Art (3)
COMM 416. International Culture and Communication (3)
DSM 410. The Global Context for Design (3)
ECON 451. International Economics (3)
ECON 455. Economic Development (3)
FDM 340. Textiles and Apparel in the Global Economy (3)
FDM 470. Global Issues and Fashion (3)
FIN 480. International Finance (3)
FOR 425. Global Forest Resources (3)
FOR 426. Global Forest Resources Practicum (3)
Foreign Culture courses (FCLT)
Foreign Language course at 300-level (3)
GEOG 310. Global Issues (3)
GSCM 470. Global Supply Chains (3)
IDT 430. Women in International Development (3)
INBS 310. Global Business Communication (3)
INBS 480. Global Strategic Issues (3)
INTS 360. The European Union and Contemporary European Affairs (3)
MANG 360. International Business (3)
MKTG 485. Global Marketing (3)
REL 102. Introduction to World Religions (3)
RPTR 351. Sustainable Tourism (3)
RPTR 353. Sustainable Tourism in Patagonia (3)
SOCA 322. Third World Development (3)
SOCA 350. Latin American Culture (3)
SOCA 351. Traditional and Changing Africa (3)
SOCA 354. Mesoamerican Archaeology (3)

**Category 5: Service Learning Elective**

AFCS 499. Global Service Learning (1-3)
ART 499. Global Service Learning (1-3)
SRVL Service Learning courses (1-6)

**Category 6: ENGR 480 Grand Challenge Capstone**

TOTAL

1 cr
16 cr

1 A student may petition to use a significant research experience and/or significant service learning experience to satisfy the category. If approved, the student may take additional approved coursework in Categories 1, 3 or 4 to acquire additional knowledge that can be used to address the grand challenge.

2 Most courses that are taken on a study abroad will satisfy the Global Awareness component. A list of courses is available; additional courses may be added by a process of petition and review.