



THAYER SCHOOL OF  
ENGINEERING  
AT DARTMOUTH

# Thayer School Grand Challenges Scholars Program

*OPERATIONAL DOCUMENT*

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# OPERATIONAL DOCUMENT – THAYER GCSP

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## Vision and Goals

*"You can't solve a problem on the same level that it was created. You have to rise above it to the next level." - Albert Einstein*

For more than 150 years, Thayer School of Engineering at Dartmouth has taken an interdisciplinary approach to preparing future engineers within the context of an exceptional liberal arts education, with a focus on both entrepreneurship and service to society. Thayer's approach consistently emphasizes the five competencies the National Academy of Engineering (NAE) has identified as crucial for future engineering education: creativity and research, multicultural understanding, multidisciplinary competency, business and entrepreneurship, and social consciousness. Because of this natural fit with the values of the NAE and the national vision for the Grand Challenge Scholars Program (GCSP), the development of the Thayer School GCSP represents an opportunity to formalize and integrate Thayer School's existing model into the GCSP framework, in furtherance of Thayer's mission: "to prepare the most capable and faithful for the most responsible positions and the most difficult service."

By building on the Thayer and Dartmouth educational model, the GCSP will strengthen institutional focus, providing additional service opportunities and experiences to broaden students' skill set and worldview. The GCSP will offer a structured and supported path for roughly 10 students per year (by year three) to deeply examine one of the 14 NAE Grand Challenges, develop innovative solutions, and meet like-minded students. Thayer School GCSP graduates will be stronger candidates for both graduate school and the job market, having gained practical experience and further developed their desire to be of service in one of the Grand Challenge areas. In addition, they will connect with other Thayer GCSP alumni through a special email group and with Grand Challenge Scholars across the country via national GCSP conferences, workshops, and communication channels.

## Program Goals

The Thayer School of Engineering GCSP is designed:

- To provide undergraduates with new opportunities to explore the most pressing problems society faces through practical education and experience.
- To enhance Thayer School's existing educational model by providing a formal pathway through which students can structure their education, international experience, and faculty support network around one of the 14 Grand Challenges, as articulated by the NAE.
- To create a diverse network of Thayer GCSP scholars and alumni who can turn to each other and to other GCSP scholars for discussion and support throughout their careers.

### **Administration and Steering Committee**

The Thayer GCSP will be administered collaboratively by a Faculty Director, a senior Thayer School faculty member, and an Administrative Director, currently the Thayer Assistant Dean for Academic and Student Affairs. The Faculty and Administrative Directors, with the support of the GCSP committee, will be responsible for the coordination of all elements of the program.

The GCSP Steering Committee will initially consist of three Thayer School faculty members appointed by the Dean of Thayer School, and could potentially include a student member after the initial two-year pilot phase. Steering committee members will collectively monitor student progress, discuss applications and project proposals each term, approve program admission and completion, adopt administrative policies, and determine program budget allocations.

Faculty members who serve on the committee, like the rest of the Thayer School faculty, may at times be called upon to serve as faculty mentors.

### **Recruitment**

Thayer School will position the GCSP as a prestigious designation and an opportunity to earn in-demand skills. Eye-catching and cohesive GCSP marketing materials will be designed as part of a multi-faceted recruitment strategy. New students will receive a flyer about the program and be directed to a page on the Thayer School website that details the program goals, requirements, and benefits. Thayer will also promote the program to prospective engineering students through email, social media, information sessions, and open houses.

Additionally, all Thayer faculty advisors will be informed of the program in detail and asked to discuss it with their first- and second-year advisees. All engineering majors at Dartmouth will watch a short, engaging presentation about the program in Thayer's required Introduction to Engineering (ENGS 21) class.

Students who have completed the GCSP and received the GCS designation will be featured in marketing materials describing engineering at Dartmouth and highlighted on the Thayer School website.

### **Application and Selection**

*Eligibility.* Dartmouth undergraduates will be eligible to apply as early as sophomore summer and as late as the end of junior year. Students in Dartmouth's Dual-Degree program complete a liberal-arts AB at a partner institution and a Bachelor of Engineering (BE) at Dartmouth. Dual-Degree students may apply any time in their first year at Dartmouth (generally their junior year).

*Application.* There will be a quarterly application deadline near the beginning of each term. An electronic application form will include a brief essay (300 words) in which applicants will discuss why they want to participate and what led them to

choose one of the Grand Challenge areas and themes. The electronic signature of the student's faculty advisor will be required on the form.

Applicants will also be asked to outline feasible options for the two major components of the Thayer GCSP—a mentored research experience or independent project (for Dartmouth credit) and a related off-term experience. Details of the off-term experience will not be required at the time of the initial application; however, thoughts on possible options should be presented. Students will also be asked to list three courses they plan to take or have taken that relate to their chosen Grand Challenge.

*Selection.* The GCSP committee will review applications quarterly to provide constructive feedback and/or approval. The hope is to admit all applicants with a reasonable plan to accomplish the program goals. Proposals for off-term experiences will also be reviewed by the GCSP committee quarterly, with the goal of having 10 GCSP graduates per year (about 10 percent of our graduating class) within three years of program inception.

### **Faculty Mentoring**

Dartmouth has a robust advising community and a well-established tradition of faculty providing guidance to undergraduates throughout their college education. Students will work with assigned faculty advisers on their GCSP application and will self-select additional faculty mentors according to their chosen Grand Challenge.

Faculty mentors will advise GCSP students on the research or independent study (for credit) portion of the program, as well as the related off-term experience. Additional course and schedule advising will be provided as needed to ensure student fulfillment of the GCSP and Dartmouth requirements, while building a strong and cohesive engineering program plan.

The GCSP committee will help recruit faculty mentors and be available to answer their questions. Over time, the committee will develop an electronic on-boarding document for new mentors, including tips and success factors.

### **Funding**

The Dean has approved a budget of \$15,000 for year one and \$20,000 for year two. After the initial two-year start-up period, the budget amount and source will be reviewed and adjusted annually based on interest and need.

Students will be required to apply for funding a minimum of one term before their off-term experience. The GCSP committee will review each proposal and make decisions on the availability of Thayer School funds to support the initiative. The committee will guide students in seeking funding from a list of additional on- and off-campus funding sources.

### **Unique Aspects**

*Educational Model.* Dartmouth provides fertile soil for the GCSP in light of the distinctive emphasis on interdisciplinary and service-oriented engineering education together with a diverse student body oriented toward these themes. Undergraduate engineering education at Thayer School already takes place against a liberal arts backdrop. Therefore, adopting a GCSP is a natural progression for Thayer's educational model and non-departmental structure.

*Enhanced AB.* The GCSP designation is expected to be particularly attractive to undergraduates pursuing an AB degree in engineering sciences, but who do not intend to stay for a fifth year to complete the BE degree. For this particular student population, this program will provide additional experience and skills that will enhance their marketability and future job performance.

*Alumni Forum.* Dartmouth College is recognized as having one of the most dedicated and responsive alumni networks in the world. Building on this unique strength, the GCSP would create a prestigious subset of alumni, connected for life through a GCSP online platform. This online forum will provide a confidential venue where Thayer Grand Challenge Scholars and program alumni can share ideas and ask questions about career, public affairs, technology, learning, teaching, and other topics. We envision eventually dividing the larger group into subgroups by Challenge area to promote more topical discussions.

## **Core Requirements**

GCSP students will identify one of the 14 Grand Challenges for Engineering around which to focus their learning and experience at Thayer. The Grand Challenges for Engineering are as follows:

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

Having selected a Grand Challenge, students will plan, propose, and complete the two primary elements of the Thayer GCSP—a mentored research experience or independent project (for Dartmouth credit) and a related off-term experience.

At the culmination of the program, students will compile a portfolio that includes the following documentation:

- A GCSP checklist with signatures from the student's faculty mentor(s) showing completion of program components;
- A reflection of 1-2 pages explaining what the student learned over the course of the program and how it relates specifically to their Grand Challenge theme and how it translates to mastery of the five program competencies;
- A copy of the written report produced as part of the research or independent project component;
- Other relevant supporting documents (optional).

Student activities within the five competency areas, as outlined below, must relate to their selected Grand Challenge theme. All program-related activities, excluding regular degree requirements, must be approved in advance by the program director and/or steering committee to ensure adherence to program standards.

## 1. Interdisciplinary Component

Thayer School of Engineering does not have departments, and many of its engineering courses are interdisciplinary by design. Examples include required undergraduate core courses in lumped and distributed systems that encompass fields normally not addressed in a single course.

Because the Dartmouth and Thayer undergraduate curricula provide such a strong interdisciplinary education, students in the GCSP will be deemed to have satisfied the interdisciplinary component of the program upon completion of the AB degree in Engineering Sciences. All Dartmouth AB candidates are required to fulfill the following course requirements: a writing course, first-year seminar, three language courses, and a minimum of 10 general education courses across eight areas, with three of these fulfilling three distinct world cultures requirements. See: [requirements for the Degree of Bachelors of Arts](#).

## 2. Research Component

GCSP students will be required to complete one of the following three courses with the project or research area being in their chosen Grand Challenge theme:

- **ENGS 86: Independent Project** – An individual research or design project carried out under the supervision of a member of Thayer School faculty.
- **ENGS 87: Undergraduate Investigations** – An original investigation in a phase of science or engineering under the supervision of a member of Thayer School faculty.
- **ENGS 88: Honors Thesis** (Honors version of ENGS 86) – A course normally elected by honors students in one term of the senior year. The student will

conduct a creative investigation suitable to the major subject under the supervision and guidance of a member of Thayer School faculty.

### **3. Entrepreneurship Component**

There are a number of ways GCSP students can fulfill the entrepreneurship requirement. All GCSP students will be required to complete a project or internship during a Dartmouth off-term that relates to their Grand Challenge theme. If this off-term experience includes an entrepreneurial component or sufficient business analysis, as approved by the faculty adviser and/or program director, the project will satisfy the requirement.

Students may also fulfill the entrepreneurship requirement by filing a patent application, participating in a pitch competition, or by participating in another significant entrepreneurial activity during their undergraduate education, with committee approval. Grand Challenge Scholars will be required to seek input from their faculty advisers and/or the program director on whether their proposed entrepreneurial activity is sufficient to fulfill this component of the program.

NOTE: All AB ENGS majors are required to take ENGS 21, Introduction to Engineering, where they learn to evaluate the technical and economic feasibility, as well as social significance, of their design projects. Students conduct patent searches, market research, and user surveys in the course.

### **4. Global Component**

The multicultural competency requirement will be met in the course of satisfying existing degree requirements for Dartmouth students. Atypical of undergraduate engineering programs, our students are required to take three language courses and three additional courses in world cultures. Dual degree students from partner liberal arts institutions will need to show documentation on how they have satisfied the global component through course work or other curricular or co-curricular activities.

In addition, all GCSP students will be highly encouraged to participate in one or more of Dartmouth/Thayer School's Foreign Study, Language Study Abroad, or Engineering Exchange Programs. Other international opportunities, such as the student-run Dartmouth Humanitarian Engineering or those offered through the [Dartmouth Center for Service](#), may be used to fulfill the multicultural/global component.

Drawing on the experiences gained through the mechanisms listed above, students will document what they learned in the context of their Grand Challenge theme.

### **5. Service Component**

The service component will be a key basis for approving student GCSP proposals, and may be fulfilled during the student's off-term experience, in combination with the global component, or through another experience at or outside of Dartmouth.

Service opportunities offered through Dartmouth include:

- [Dartmouth Center for Service](#)
- [Schweitzer Fellowships](#)
- [Thayer Student Groups](#)

### **Mentorship, Support, Tracking, and Assessment**

GCSP students will be mentored by their faculty advisors and will receive feedback from the GCSP committee at the time of their application and on their off-term experience proposals.

Once a student has been admitted to the GCSP, administrative staff will add the student to the Thayer GCSP tracking system and initiate regular program communications and progress check-in emails with the student.

The GCSP committee will review students' final portfolios, request additional detail or work if necessary, and determine satisfactory completion of the program requirements. NOTE: Components completed prior to the student's admission to the GCSP can be used to satisfy the requirements. Students must meet quarterly deadlines for the submission of final program portfolios to receive the GCSP designation.

### **Recognition**

The GCSP designation will be announced as scholars receive their degrees at Thayer School's annual investiture ceremony. At an annual dinner to honor GCSP participants, a former Grand Challenge Scholar will serve as the guest speaker. Participants also will be highlighted on the Thayer School website.

Students who successfully complete the program can list the GCSP designation on resumes and applications for jobs and graduate school. Faculty mentors will refer to the student's work in the program in letters of recommendation.