NASA Connecticut Space Grant Consortium
Community College Quadcopter Challenge (CCQC)
2023-2024

About NASA CTSGC History: In order to encourage broader participation in NASA research programs, Trinity College, University of Connecticut, University of Hartford, and the University of New Haven formed the Connecticut Space Grant College Consortium in 1991. The philosophical intent of this program was, and continues to be, to build a research infrastructure in Connecticut which supports the aerospace, space science, engineering and technology related initiatives of federal and state government and private industry.

NASA Connecticut Space Grant Consortium (CTSGC) is one of 52 state-based, university-led Space Grant Consortia funded by NASA Office of STEM Engagement (OSTEM). NASA CTSGC is headquartered at the University of Hartford, with 24 affiliated post-secondary education institutions in Connecticut. It's to develop and implement student fellowship and scholarship programs, interdisciplinary space-related research infrastructure, education, and public service programs; and cooperative initiatives with industry, research laboratories, and state, local and other governments. Space Grant operates at the intersection of NASA's interest as implemented by alignment with the Mission Directorates and NASA CTSG's interests. Although it is primarily a higher education program, Space Grant programs should encompass the entire length of the education pipeline, including elementary/secondary and informal education. NASA CTSGC is a Capability Enhancement Consortium.

To support a community college-based program in NASA's Aeronautics Mission Directorate, the NASA Connecticut Space Grant Consortium (CTSGC) is pleased to support a community college-based CCQC to improve STEM recruitment and retention. This program is designed to:

(1) increase the number of community college students who graduate with STEM degrees and/or transfer to STEM programs at four-year institutions,

(2) increase the ability of community college faculty members to deliver aerospace/aeronautical-related content in areas of interest to NASA, and

(3) enhance the diversity of students pursuing STEM education at Connecticut community colleges.

These objectives will be accomplished by the use of small model helicopters (quadcopters) in competitions between student design groups from the Connecticut community colleges. These design groups will be led by faculty advisors at the various community colleges.

Quadcopters will be used for the challenge because kits and parts are readily available. Experience has shown that compared to fixed-wing, radio-controlled airplanes, students can quickly learn to pilot quadcopters and they can be operated in small spaces (including indoors) with no infrastructure (which is not the case with fixed-wing, radio-controlled airplanes). Each student team will first build and learn to fly a quadcopter made from off-the-shelf components. They will then significantly modify their kits in order to accomplish the challenge tasks. This will involve some mechanical design and fabrication, giving the students experience with computer-aided design (CAD) software, 3D printing, and laser

cutting. To accomplish the autonomous flight portion of the challenge, teams will also learn computer or microcontroller programming, in addition to mounting sensors and logging data.

Competition and Team Setup:

1. Up to five student teams (maximum) of 3 to 6 students each will be selected to participate, each advised by a community college faculty member.
   a. No previous expertise is expected from student participants.
   b. Each team should contribute to diversity goals and have at least 40% under-represented students.
   c. Each student participant will achieve "significant engagement" level over the course of the challenge, 80 hours' minimum commitment, and will receive a $1,000 stipend.
   d. The faculty advisor will receive a $2,000 stipend.
   e. Match or Cost-share must be provided by the faculty advisor's institution at 1:1; to meet the faculty stipend of $2,000.

Application Process:

Interested faculty should recruit student participants.

TIP: Ask specific students if they would be interested! This has shown to be an effective way to recruit students who might be interested but might not have thought to apply themselves.

1. The faculty advisor/PI must:
   a. Apply using this application link: Application can be found here
   b. Submit the **Team Information Form**
   c. Submit a **Faculty Narrative**
   d. Submit a **Contact and Demographic Form** for themselves

2. Each student participant must:
   a. Apply using this application link: Application can be found here
   b. Be a US Citizen in order to be paid
   c. Be a full-time student (12 credits), during the Fall 2023/Spring 2024 semesters.
   d. Be a student in satisfactory academic standing.
   e. Submit a **Student Transcript** satisfying the previous requirements (included in application)
   f. Submit a **Contact and Demographic Form** for themselves
   g. Submit a **Survey of Skills** for themselves: The Survey of Skills is included in the application, and can also be found here.

Selection Process:

As many teams as possible will be accepted, but if more teams apply than there are available spots, selection will be made based on (in order of importance):

1. Institutional diversity (spreading opportunities out to additional colleges over additional teams from the same college)
2. Increased student participation (spreading opportunities out to larger numbers of students, e.g. a team of 5 is preferred over a team of 3)
3. Diverse Teams (spreading opportunities out to teams that reach diversity goals.)
4. Evaluating faculty narrative for likelihood of team success.

Challenge Schedule:

1. **Kick-off**: A mandatory kick-off meeting will be held to distribute kits to each team and provide program information. The kickoff meeting is planned for **November 10, 2023 (noon – 2PM)** at the New England Air Museum.
   a. Students should attend in person.
   b. Quadcopter parts will be distributed, so the faculty advisor is responsible for making sure that **at least 1 person from each campus arrives in person** to collect the relevant equipment.
   c. Information will be presented covering the expectations of the challenge, as well as some relevant skills that will help the teams get started on their tasks.
2. **Design, Build, and Practice**: during spring teams will:
   a. Build their quadcopter, using information available at the space grant website (https://ctspacegrant.org/events/community-college-quadcopter-challenge)
   b. Practice flying their quadcopter safely and legally.
      i. **Wear safety glasses and have rotor protection installed for indoor flights**.
      ii. Register their drone for any outside flights (https://faadronezone.faa.gov/#/), and follow FAA regulations.
   c. Design modifications to accomplish tasks according to the rubric. This includes:
      i. **Submit any purchases according to the timeline and budget specified at the kick-off**.
      ii. Design and draw rotor protection using CAD software. iii. Fabricate and install rotor protection.
      iv. Design and fabricate a camera mount.
   d. Prepare the final report for the challenge via this link. In addition to the report requested, include the following:
      i. Make a 2-3 minute **video** describing the quadcopter and how it intends to accomplish the challenge, post on YouTube, and submit YouTube link in your report
      ii. Create a **poster** to aid in the Oral Flight-Readiness Review (FRR) presentation and submit electronic version of the poster in your report
      iii. Submit any additional documentation in the final report.

3. **Day of the Challenge**:
    a. Team will arrive at the specified location and time with quadcopter, extra parts, poster, and video.
    b. Team will show their pre-made video.
    c. Team will present their Oral Flight-Readiness Review (FRR): including their design modifications and capabilities.
    d. Team will demonstrate quadcopter capabilities according to the rubric.
    e. The challenge will take place on a Friday in April. The date and location of the challenge are currently planned for Friday, April 19, 2024 at the Central Connecticut State University campus. This information and a start time will be confirmed at a later date.
4. **After the challenge**:
    a. Each student must:
        i. Submit a **CCQC Student Report** to the CTSGC office. This report will be required within 30 days of the end of the Period of Performance. The link to the required report will be sent via email prior to the end of the Period of Performance. The report may also be found when logging into the awardee's InfoReady portal and selecting the "Reports" tab from the main menu.
        ii. Submit a **Post Survey of Skills.** , which is included in their student report.

    NOTE: Most forms available online

    b. Each faculty advisor must:
        i. Submit a **Report Form** which will be assigned via email following the challenge date. A final report will be required within 30 days of the end of the Period of Performance. The link to the required report will be sent via email prior to the end of the Period of Performance. The report may also be found when logging into the awardee's InfoReady portal and selecting the "Reports" tab from the main menu

Timeline

October 13:	Applications are due - *Priority Deadline* *(we will accept applications until all team slots are filled)*
November 1:	Accepted teams are contacted with information about the kick-off
November 10:	Tentative Kick-off Meeting AT New England Air Museum
February:	Suggested supply purchase deadline. Please consider shipping times when purchasing supplies, and make purchases earlier rather than later.
April:	Quadcopter Challenge *(tentatively scheduled for 4/19/2024 at CCSU)*
	Final Reports submitted by Faculty PI and Student Direct Participants (within 30 days of Challenge date)
	Videos uploaded to YouTube and link submitted in report
	Electronic poster submitted in report
May:	Final paperwork submitted

Budget

Up to five teams, maximum, will be selected for this year's CCQC.

Each team can be reimbursed up to $1,000 for all the materials for the project. Estimates of the material costs should be included in the PI application budget worksheet and detailed in the narrative. Please consult your institution regarding the purchase of your supplies. Reimbursement of supplies purchased will be made when CTSGC office receives an invoice from your institution.

Each student receives $1,000 as stipend. Faculty advisor receives $2,000 as stipend.

Invoices must be received no later than 60 days from the end date of the period of performance.

Challenge Rubric and Evaluation

A team of judges from 4-year institutions and/or industry will score challenge teams based on how well they accomplish tasks according to this rubric (see quadcopter challenge website for any modifications or updates to this rubric):

Total Pts	Evaluation Criteria	Point Allocation Specifics	Points
10	**Video** - The team must create a video describing their quadcopter and how it intends to accomplish the challenge. 2-3 minutes long each, to post on YouTube.	Video uploaded on YouTube and link submitted by deadline	2
		Content - interesting information (can vary, should include what students learned and how they intend to address the challenge)	5
		Polish - professional presentation (well-lit, in-focus video audible audio, good editing, etc.)	3
10	**Poster and Presentation -** Poster and presentation are professional, and polished. The content will be judged in the following sections.	Poster is professional and polished (good use of space, effective pertinent visuals, judicious text)	5
		Presentation is practiced and within time limit	5
10	**Weight Reduction -** Design to minimize weight.	Overall Weight (8-6-4-2)	8
		Innovative weight reduction	2
10	**Rotor Protection** - The team must design (using a CAD package), fabricate, and install rotor protection for the quadcopter. Required whenever flying the quadcopter.	Rotor Protection is CAD designed	2
		Rotor Protection is implemented	2
		Rotor Protection is securely attached	3
		Rotor Protection is effective	3
10	**Camera Mount**	Camera Mount attached	2
		CAD-drawn	2
		Fabricated via 3D printing and/or laser cutting	2
		Switchable between outview and downview within 60 seconds	2
		Doesn't use Velcro or tape	2
10	**Multi-pilot -** 3 team members must demonstrate basic flying skills by taking off from one location,	Quadcopter can fly	1
		1st Pilot successful flight	3
		2nd Pilot successful flight	3

Total Pts	Evaluation Criteria	Point Allocation Specifics	Points
	clearing a 5 foot obstacle, and landing at another, within 60 seconds.	3rd Pilot successful flight	3
15	**Sample Return (1 pt per 2 g returned, up to 5 pts for 10 g) -** Return the sample to outside the exploration area.	Gravel Sample - up to 10 g	5
		Sand Sample - up to 10 g	5
		Water Sample - up to 10 mL	5
20	**Autonomous Flight** - Take off, rise to 2 meters, hover in place for 30 seconds, and land safely.	Autonomous takeoff, rise to about 2 meters, hover for 30 seconds, safe landing	5
		Autonomous takeoff, clear 5 foot obstacle, land at a different position	5
		Autonomously survey the 20'×20' arena, taking top-down photo/video of the space	5
		Autonomous sample return - retrieve a material sample autonomously	5
15	**Photography** - successful photos of various targets	Horizontal target	5
		Vertical target	5
		All landscape features included	5
25	**Mapping** - a map of the quadcopter arena to be reconstructed from photo or video (note: a single top-down screen shot of a 3D map counts as a 2D map as well)	Prior 2D map reconstruction demonstrated during presentation	5
		2D map reconstructed from actual challenge arena	5
		Prior 3D map reconstruction ability demonstrated during presentation	5
		3D map reconstructed from actual challenge arena	5
		Real horizontal lengths & elevations	5
		total	135