

COMSTAC STEM Working Group Draft Report
STEM Education Needs for the FAA and Commercial Space Industry
May 15, 2023

Purpose

The purpose of this report is to describe how the commercial space industry is currently engaged in STEM initiatives and provide recommendations to the FAA for partnering with industry to encourage greater diversity and participation in STEM education supporting the growing need in the commercial space workforce.

The US space program must protect access to space for US companies and the Nation, promote economic development and remain innovative. A talented workforce remains a critical component of our nation’s goals. Space is inspirational across multiple generations, and it is imperative we translate that passion into jobs for a growing industry.

The space workforce is rapidly growing, with 151,797 jobs in the core space sector in 2021; the launch sector alone has increased this number by 18% over the past five-years.¹ With the shift toward commercialization of the launch sector, and to regional space hubs and spaceports, leadership from FAA AST will be vital in identifying workforce gaps and potential government/industry/academic partnerships.

Recommendations

To encourage greater diversity and participation in STEM education, the COMSTAC working group developed the following recommendations for the FAA to consider:

- Work closely with National Space Council and its member agencies to speak with a unified voice and minimize duplication:
 - Ensure harmonization between The Department for Transportation (DOT) STEM workforce efforts and the White House-led Space Industry Skilled Workforce Coalition.
 - Create a space workforce messaging portal and newsletter to notify STEM workforce partners of opportunities.
 - Facilitate participation from historically excluded academic communities at space conferences and workshops.

¹ Bruno, Michael, “Space Report: Decade High In Employment, But Still Not Enough” Aviation Week, 4 April 2022 <https://aviationweek.com/shows-events/space-symposium/space-report-decade-high-employment-still-not-enough>

- Work with Industry to:
 - Establish a mechanism for industry inputs into the DOT-related tasks of the Interagency Roadmap to Support Space-Related STEM Education and Workforce.²
 - Establish executive-level workforce development officers to build strong local and regional STEM workforce pipelines, including developing regional postsecondary STEM internship programs.
 - Allow designation of FAA-licensed spaceports as regional education hubs to support programs and promote space industry activities for students early in their education.

- Work with Middle Schools, High Schools, Universities, and Student Organizations to:
 - Highlight space industry jobs available and identify academic and extracurricular points of engagement within FAA AST.
 - Extend the Department of Labor’s Space-focused Apprenticeship Accelerator model to promote areas of research interest to FAA AST and support the space industry’s workforce pipeline, like the U.S. Space Force University Partnership. This pipeline should emphasize the employment of historically excluded communities in commercial space transportation.

Background

National Space Council Collaboration

Recommendation: Ensure harmonization between DOT STEM workforce efforts and the White House-led Space Industry Skilled Workforce Coalition.

Vice President Harris announced in September 2022 a new White House-led Space Industry Skilled Workforce Coalition.³ As part of this effort, FAA AST should work with the National Space Council staff, NASA, Department of Commerce, Department of Labor, and Department of Education to identify company workforce needs and develop job training programs to fill gaps in these areas. They should additionally work to promote lesser-known career paths into the space industry from trades to non-technical careers in order to ensure the top talent from all disciplines is encouraged to join the space sector. Programs that may facilitate opportunities for participation

² The Interagency Roadmap to Support Space-Related STEM Education Workforce, National Science and Technology Council and Office of Science and Technology Policy, September 2022, <https://www.whitehouse.gov/wp-content/uploads/2022/09/09-2022-Interagency-Roadmap-to-Support-Space-Related-STEM-Education-and-Workforce.pdf>

³ FACT SHEET: Vice President Harris Announces Commitments to Inspire, Prepare, and Employ the Space Workforce, White House, 9 September 2022, <https://www.whitehouse.gov/briefing-room/statements-releases/2022/09/09/fact-sheet-vice-president-harris-announces-commitments-to-inspire-prepare-and-employ-the-space-workforce/>

include NASA’s HUNCH Program, which focuses on skill-building through hands-on experience for students working on projects that are used for the International Space Station.

Recommendation: Create a space workforce messaging portal and newsletter to notify STEM workforce partners of opportunities.

There is not currently a centralized location or newsletter for teachers and students at middle, schools, high schools, community colleges, and universities or young professionals to learn about space industry pre-apprenticeships, apprenticeships, internships, scholarships, and opportunities. One attempt to manage a comprehensive online database is a volunteer-maintained website www.spaceinterns.org, but a government-maintained newsletter and website that could distribute opportunities on a regular basis, including industry internships or other programs, would be key in expanding access to opportunities, particularly for students from less resourced schools. The Air Line Pilots Association (ALPA) has a portal that can serve as a model, www.AviationWorks4u.org – a collaborative site that shares information and provide guidance for those seeking careers in various paths in the aviation industry.

Recommendation: Facilitate participation from historically excluded academic communities at space conferences and workshops.

FAA AST should work with the National Space Council and academic partners to increase the participation of students from historically excluded communities at space conferences and workshops. This may include working with State-level space grant consortia to identify opportunities for student participation in commercial space conferences and allocating funding for student participation in those conferences, hosting pre-event workshops for students and young professionals, and actively encouraging participation from diverse communities at FAA AST events.

Industry Collaboration

Recommendation: Establish a mechanism for industry inputs into the DOT-related tasks of Interagency Roadmap to Support Space-Related STEM Education and Workforce.

DOT and FAA took part in the development of the Interagency Roadmap to Support Space-Related STEM Education and Workforce. There are three areas of work identified for DOT in support of the goal to inspire greater engagement from educators and learners in space-related STEM content and fields:

1. Increase awareness of the breadth of space-related careers.
2. Provide a coordinated set of resources for educators to use in providing STEM content through a space lens.

3. Support STEM educator professional development.

Numerous space industry organizations host programming for students and educators, without a centralized database of these opportunities. Given limited resources within FAA AST and the breadth of existing NASA outreach, AST should focus on serving as an aggregator of existing opportunities in the commercial sector as a supplement to NASA work.

Recommendation: Establish executive-level workforce development officers to build strong local and regional STEM workforce pipelines, including developing regional postsecondary STEM internship programs.

FAA AST, in coordination with National Space Council organizations, should utilize its connections with regional space organizations, economic development organizations, and spaceport authorities to develop local STEM workforce pipelines.

Executive-level workforce development officers and STEM champions, who are separate and distinct from the more general human resources function and who are dedicated to developing unique, community-focused relationships, are needed to identify talent pools. FAA AST and the National Space Council should work to identify potential local and state-level workforce champions, particularly in existing aerospace hubs.

The National Space Council has three regional pilot programs in Florida's Space Coast, the Gulf Coast of Louisiana and Mississippi, and Southern California which are a collaboration with service providers such as community colleges, unions, and industry to demonstrate a replicable and scalable approach to attracting, training and creating employment opportunities for people from backgrounds traditionally underrepresented in STEM jobs.

FAA AST and the National Space Council should also work with these organizations to encourage proactive use of internships, externships, apprenticeships and co-op opportunities between industry, academia, and government to foster STEM interest and provide meaningful work experiences and real post-internship opportunities. They should encourage regional cross-collaboration in best practices in establishing aerospace pipelines.

Recommendation: Allow designation of FAA-licensed spaceports as regional education hubs to support programs and promote space industry activities for students early in their education.

While NASA is the primary federal entity engaging with students in space education, FAA AST should promote the use of FAA-licensed spaceports as regional education hubs, for hands-on experiences both in grades K-12 and at universities. Spaceport developments have gravitated toward aerospace business hubs that catalyze interest, investment, and job creation for their larger communities. FAA-licensed spaceports can serve as both a conduit and coordinator for

their industry tenants in introducing and promoting their endeavors to regional academic communities. Tours of facilities can provide introductions to young students on STEM programs happening in their local areas. Paid internships with regional high schools and universities provide opportunities for students to get hands on experience. Special programs for regional students tied to the spaceports business activities (launches, tests, rollouts of new hardware, etc.) can bring together government, commercial and academic interests in the industry and generate excitement in STEM. FAA AST should aggregate information on existing programming at spaceports and should work with NASA Space Grant Consortia to promote these programs.

University and Student Organization Collaboration

Recommendation: Highlight the types of jobs available in the space industry jobs and identify academic and extracurricular points of engagement within FAA AST and commercial space transportation industry

FAA AST should work to highlight space industry jobs and new opportunities the space industry is providing, including utilizing commercial astronauts to promote space jobs. In addition to aggregating existing industry opportunities, FAA AST should clearly identify key impact points of academic and extracurricular engagement. Key points of national extracurricular engagement include the Space Generation Advisory Council, Students for the Exploration and Development of Space, American Institute of Aeronautics and Astronautics student chapters, Society of Hispanic Professional Engineers, National Society of Black Engineers, American Indian Science and Engineering Society, and Society of Women Engineers.

Recommendation: Extend the Department of Labor’s Space-focused Apprenticeship Accelerator model to promote areas of research interest to FAA AST and support the space industry’s workforce pipeline, like the U.S. Space Force University Partnership. This pipeline should emphasize the employment of historically excluded communities in commercial space transportation.

The U.S. Space Force University Partnership Program has four aspects:⁴

1. Establish opportunities for world-class research, advanced academic degrees, and workforce and leadership development for USSF Guardians.
2. Identify and pursue research areas of mutual interest with member universities, individually and collectively.

⁴ “U.S. Space Force names Clemson Its Newest Strategic Partner”, Clemson News, 18 July 2022, <https://news.clemson.edu/u-s-space-force-names-clemson-university-its-newest-strategic-partner/>

3. Establish scholarship, internship and mentorship opportunities for university students and ROTC cadets.
4. Recruit and develop diverse officer, enlisted and civilian Guardians with a particular focus on science, technology, engineering, and mathematics

In addition to a focus on strategic research and education, FAA AST should utilize the Department of Labor's Space-focused Apprenticeship Accelerator model to help educate and create a pipeline for the next generation of space industry professionals in STEM fields. The Department of Labor announced the Registered Apprenticeship Accelerator program in April 2022. It is designed to meet the space industries' workforce needs and meet diversity, equity, and inclusion goals. This effort should also aim to increase shared knowledge of the implementation of commercial launch and regulatory processes within academia, industry, and the agency. In utilizing or extending the Apprenticeship Accelerator focused on space industry workforce development, AST should consider partnering with Minority-Serving Institutions to increase the diversity of the space transportation workforce. AST should additionally look to regional industry spaceports and development agencies to partner in these endeavors, both financially and programmatically.

Appendix: Example Industry Space Workforce Engagement

This appendix highlights some of the existing industry opportunities for students and workforce development. We encourage FAA AST to use this list as a starting point to aggregate other opportunities, both national and regional.

National Student Internship Programs

- [Space Workforce 2030](#)
 - Space Workforce 2030's National Space Interns program seeks for the first time in 2023 to create a common app-type experience for internship applications and currently features 30 companies.
- [Brooke Owens Fellowship](#), [Matthew Isakowitz Fellowship](#), [Patti Grace Smith Fellowship](#), [Zed Factor Fellowship](#)
 - Four U.S. fellowship programs exist which place students at well-paid aerospace internships across the country and provide mentoring support. These fellowships are: The Brooke Owens Fellowship, for undergraduate women and gender minorities in all fields; The Patti Grace Smith Fellowship, for Black undergraduates seeking their first aerospace internships; The Matthew Isakowitz Fellowship, for technical undergraduate and graduate students; and The Zed Factor Fellowship, for undergraduates from historically excluded communities. Each of these programs takes 20-50 students annually and places students at top aerospace companies for summer internships (in the case of Zed, also fall), provides both an executive-level and young professional mentor for each student, and convenes the fellows at an annual summit. Zed Factor additionally includes a community engagement component, where each fellow receives funding and mentorship to carry out an aerospace-related community service project over the course of the following academic year.

Regional Internship Programs

- [Virginia Space](#) dedicates human and financial resources to its internship program. The goal of the program is to develop a workforce in our own community. Our summer internship program has hosted around 10 university-level students per year over the more than decade-long duration of the program. About 20% of Virginia Space's workforce began as interns. Five of the nine summer 2022 interns are now employees. Our internships give students real experience doing actual work for the spaceport, including such diverse tasks as building electrical boxes and developing integrated systems schematics for launch pads, managing the supply chain, technical design work and creating interactive troubleshooting tools. Students cite high satisfaction with the program and especially note the hands-on industry experience they gain. Recognizing both the utility to the team and the popularity to students, we have established a year-round internship

starting January 2023. We also partner with several universities for co-op programs, externships and experiential visits and have established MOUs with multiple organizations.

- In 2015, [Space Florida](#) hosted the first of what would prove to be many Aerospace Workforce Summits geared to better meet the new talent demands of the growing commercial space manufacturing cluster at the Cape. The direct result of that was the evolution of the apprenticeship/certification programs recently recognized to enhance as one of the 3 national locations at the last National Space Council meeting in Houston. Additionally, building on that momentum, the State of Florida announced a few months ago an additional \$30M in workforce training focused upon the Space Coast region.

Post-Secondary Student Programming and Conference Scholarships

- [Space Generation Advisory Council \(SGAC\)](#)
 - The Space Generation Advisory Council (SGAC) is a U.N.-affiliated organization founded in 1999 which promotes international participation of students and young professionals under 35 in the space sector, and has 21000+ members globally. The primary mechanisms of engagement in SGAC are conference programming and conference scholarships, as well as 11 active project groups. The primary events for U.S. student participation include SGx, a TedX-style talk series during the annual Satellite conference in Washington, DC; Space Generation Fusion Forum, a three-day event prior to Space Symposium in Colorado Springs for several hundred delegates; and the Space Generation Congress, a four-day event prior to the International Astronautical Congress.
- [Students for the Exploration and Development of Space \(SEDS\)](#)
 - SEDS, founded in 1980, now has over 100 chapters at U.S. colleges and high schools, as well as several international offshoots. The primary mechanisms of engagement for SEDS are largely through student chapters. Individual membership is possible through SEDS but not common. Chapter programming varies widely from chapter to chapter, but chapters are encouraged to participate in national competitions including rocketry, cubesat design, and space mission design. SEDS additionally has an annual three-day conference, SpaceVision, which rotates between chapters. SEDS offers occasional conference scholarships to members. SEDS also runs an annual summer-long graduate school application bootcamp, which features weekly assignments and webinars over eight weeks that walks students through when/if they should apply to graduate school, the type of program that would be a good fit, matching students with mentors in their fields, financial aid, essay-writing, resumes, scholarships/fellowships, and more. Approximately 100 students participate in this program nationwide annually, and in 2022 four students

received the National Science Foundation Graduate Research Fellowship, one of the most prestigious graduate fellowships.

- [American Institute of Aeronautics and Astronautics](#)
 - The American Institute of Aeronautics and Astronautics (AIAA) has 240 student branches and 7500 members worldwide. AIAA chapters participate in student regional conferences and several competitions, including the Spaceport America Cup; Design, Build, Fly; and annual design competitions. Some AIAA students also participate in the Women of Aeronautics and Astronautics (WoAA), which has 18 U.S. chapters and encourages technical and professional development for its members through workshops, panels, and conferences. Additionally, the AIAA Diversity Scholars program is a program which sponsors undergraduate and graduate students from historically marginalized communities to attend AIAA's three annual forums: ASCEND, SciTech, and Aviation. In this program, 15-30 students across the U.S. are selected to attend each forum and receive scholarships to cover transportation, hotel, registration, and food. AIAA also has national academic scholarships for student members.
- Additional student funding/conference opportunities [may be found here](#)

Additional Post-Secondary Competitions and Training programs

- [University Nanosat Program](#)– helps universities and students launch small satellites
- [RockOn! Rocket Workshop](#)– build and launch a sounding rocket
- [Mission Astro Access](#)– Program to promote disability inclusion in space exploration; launches people with disabilities on Zero-G flights as a first step toward spaceflight
- [Caltech Space Challenge](#)—every other year weeklong challenge with two teams of 16 students to design a mission; they sponsor your travel/housing/food, and it is an amazing experience (application due December of even years)
- [Stuttgart Space Station Design Workshop](#)—like the above, but annual and young professionals can also apply
- [Manfred Lachs Space Law Moot Court Competition](#)—Annual international space law competition
- [NASA L'Space Academy](#)—12 week online program for undergrads to learn mission protocols, procedures, and practices, as well as a proposal writing academy for undergrads and grads
- [NASA RASC-AL](#)– mission engineering architecture competition

Scholarship programs

- [AWS InCommunities Scholarship Program](#) is for high school seniors who plan to pursue STEM subjects at higher education institutions. These scholarships are offered specifically to students in designated districts of California, Oregon, Ohio, and

Virginia, where we have data center operations. We have granted 120 renewable scholarships to students since we launched this initiative in 2019.

- Washington Space Business Roundtable provides funding to Washington, DC metro area students and teachers in space and STEM activities.
- SSPI WISE Scholarship programs
- Society of Satellite Professionals International scholarship programs
- www.spaceinterns.org has an extensive list of scholarships, internship, and fellowship programs

Industry DEI Initiatives

- [Space Workforce 2030](#) COE group will target knowledge sharing amongst the 30 companies to develop best practices that will enhance representation of women and people of color in the areas of recruitment, representation, retention, advancement and engagement. Their work will ultimately be shared at 2023's Space Symposium.
- Amazon has had success identifying alternate pipelines and continuing to increase growth within veteran and military spouse hiring. Kuiper's work relies on niche talent that is inherent in the skillsets and experiences of military personnel. This includes the necessary functional technical skill sets as well as the leadership attributes that are critical to Kuiper's mission. In 2023, we plan to explore other Amazon programs to increase our veteran population, with a focus on technician hiring for manufacturing and avionics as well as software development engineers. Amazon also inspects the employee lifecycle to understand and implement solutions for the most vulnerable communities within Kuiper, and measures progress and competency of foundational and fundamental DEI related training for leaders.
- Virginia Space has a recently-hired dedicated Director of Educational Talent to facilitate and accelerate our STEM development and outreach efforts, further developing the internship program, relationships with local schools and universities, and on-site education programs and tours.
- The [Women of Color STEM Conference](#) is committed to establishing a strong foundation for the STEM pipeline and extending it to pre-college students, particularly those who face social and economic hurdles that may hinder their pursuit of a career in science, technology, engineering, or math. The conference collaborates with STEM-related enterprises, military personnel, and universities, bringing together pre-college students through conference attendance. Students participate in interactive, competitive activities that instill a sense of enthusiasm and encourage them to consider STEM careers as genuine vocation choices. The pre-college program also features STEM professionals who can visit classrooms to share their own career journeys, providing valuable insights into working in STEM fields and answering student questions.

K-12 Industry Outreach

- Space Workforce 2030 seeks to sponsor K-12 programs that collectively reach over 5,000,000 underrepresented students annually.

- [Blue Origin Club for the Future](#) sends postcards to space, develops space-focused curriculum, and offers access to space on Blue Origin's rockets.
- [American Rocketry Challenge](#)
- [Amazon Future Engineer](#) is a computer science and STEM education program that seeks to afford young people the opportunity to explore their potential. It is aimed at increasing access to computer science education for children and young adults from underserved and underrepresented communities.
- The [Devices and Services Community and Emerging Talent \(CET\) Program](#) builds pathways in science, technology, engineering, and math (STEM) education for students from historically excluded communities to ensure a diverse talent pool. Our educational programs help students develop skills throughout progressive stages of life through STEM exposure, education, and applied experience. The three [programs](#) are AHEAD, JumpStart and AmazonNext.
- [Greene Scholars'](#) 2022 Summer Science Institute (SSI) was hosted by Amazon/Lab126/Bay BEN (Black Employee Network) between June 6-10th 2022. After a two-year hiatus, the third Amazon high school GSP-SSI returned to explore concepts in HW and SW product development specifically focused on Project Kuiper. This was a wonderful opportunity to introduce some of our best and brightest minds to Amazon's unique culture and our product development process. The Dr. Frank S. Greene Scholars Program helps youth of African ancestry in San Francisco Bay Area communities successfully complete higher education in science, technology, engineering and/or math (STEM), and serve as positive role models and contributors to their communities. They will return in 2023 for another year of program with Amazon.
- Amazon initiatives that are specific to rural America include: AWS InCommunities programs that utilize AWS's unique resources to expand access to STEM. These programs include: [Girls' Tech Day](#), [AWS Think Big Spaces](#) and our newest initiative launching this year, [AWS CloudRoom](#). The team also develops partnerships with local schools and organizations that share our commitment for STEM education, equity, and access.
- To encourage STEM among K-12 students, Virginia Space supports the Virginia Space Coast Scholars (VSCS) a program under the umbrella of the Virginia Space Grant Consortium, which is a coalition of five Virginia colleges and universities, NASA, state educational agencies, Virginia's Center for Innovative Technology, and other institutions representing diverse aerospace education and research. For example, through virtual tours of MARS facilities, three groups of highly motivated tenth grade Virginia students, along with science teachers, undergraduate students and staff, received an up-close look at MARS operations and Virginia Space's mission. It was an excellent opportunity to engage with science-focused students while promoting the spaceport and encourage students to pursue the company's well-established internship program
- Virginia Space annually supports the Virginia Space Flight Academy (VSFA), a Wallops-area non-profit organization that promotes STEM education by providing six weeks of co-ed residential summer camps for students aged 11-16 years. Virginia Space provides four VSFA scholarships annually and tours of the spaceport to build enthusiasm for and encourage STEM education. Sean

Mulligan, Virginia Space COO, serves on the VSFA Board of Directors, providing direct support and guidance for the space camp.

- The Air & Space Force Association (AFA) offers a STEM program called [StellarXplorers](#).
- The American Association of University Women offers a STEM program for 8th grade girls, called [Tech Trek](#).
- [AstraFemina](#) is a non-profit organization that reaches out to young girls through Girl Scouts of the USA Girlstart, Scobee Education Center, Artemis Program & STEM Summit, Museum of Discovery, Girls In STEM, Techbridge Girls, Million Girls Moonshot, Rosie Riveters, Texas After School Centers on Education, InspiHER, TechTrek. We team with existing organizations that already have strong STEM outreach programs, serving as a resource for these organizations to help them inspire girls and young women to not only dream big, but to pursue those dreams as well. Our cadre of successful STEM leaders provides concrete examples of what women can achieve. STEM.<https://www.astrafemina.org/>
- Society of Women Engineers (SWE) has STEM Pathways, STEMNext (for K-12)
- Society of Hispanic Professional Engineers (SHPE) has a [Pre-college program](#) for K-12
- National Society of Black Engineers (NSBE) has [Pre-college initiatives](#) as well for K-12
- [Higher Orbits](#) is a non-profit with the mission of promoting Science, Technology, Engineering and Math (STEM); along with leadership, teamwork, and communication through the use of spaceflight.
- The [National Academy of Engineering](#) has a program called [Engineer Girl](#) that is quite successful

Industry job postings

- [Space Talent](#) is a free career platform at the intersection of space and tech. They host over 15,000 jobs and share career advice from founders, employees, and interns at major space companies.
- [Careersin.space](#) has a number of postings, [SGAC has a jobs board](#), [Space-Careers](#) and [Space Individuals](#) have a number of (largely European) postings. [Spacely.work](#) is a platform to find freelance work at all levels

Additional workforce programs of note

- The Department of Labor's **Call to Action: [Youth Employment Works Call to Action \(dol.gov\)](#)**
- The **Career Trajectories and Occupational Transitions** dashboard and analytic project that lays out the idea of "launchpad" occupations: <https://www.dol.gov/agencies/oasp/evaluation/resources/career-trajectories-and-occupational-transitions-dashboard>
- USAF Academy established the [i5 Space](#) organization. I5 Space is a national student organization that operates under the U.S. Space Force's Space Training and Readiness and Command (STARCOM). They aim to deliver educational, training, and professional

development resources to students around the country who are interested in pursuing a career in the newest branch of the US military—the Space Force.

- ASU offers an Executive Master of Global Management (Specialization in Space Leadership) in the [Thunderbird School of Global Management](#). They also offer courses internationally for STEM at their campuses.
- The [NASA HUNCH](#) program is a nationwide instructional partnership between NASA, high school students and intermediate/middle school students, and early college students to produce capability for the astronaut's use on the international space station.