Virginia Space Grant Consortium (VSGC)
Body of Proposal

Overview of the Virginia Space Grant Consortium

The Virginia Space Grant Consortium (VSGC) proposes to continue to conduct a portfolio of impactful STEM engagement, education, and workforce development programs aligned with the VSGC strategic plan, NASA's Office of STEM Engagement goals, NASA Space Grant goals, and the goals of the Commonwealth of Virginia. VSGC embraces the National Space Grant program goal of contributing to the nation's science enterprise and to NASA's mission directorates by funding education and research projects. The VSGC is proposing a comprehensive suite of higher education and precollege programs to increase participants' and stakeholders' understanding of STEM, space, and aeronautics. VSGC is committed to developing and implementing programs that align with NASA's mission directorates and bolster the STEM pipeline. VSGC will assess all program activities and implement evaluation and continuous improvement strategies to ensure alignment with NASA and Consortium goals.

VSGC is actively engaged with the state's executive and legislative branches. Strong partnerships with NASA members, state agencies aligned to NASA interests, university members and statewide community college members offer unique partnership opportunities in meeting NASA and state goals. The Consortium's focus and reach is statewide and national for some programs. In addition to National Space Grant goals, VSGC aligns itself with state needs as identified by the Governor's office and state educational agencies.

All precollege programs are aligned to the Virginia Department of Education's (VDOE) state Standards of Learning (SOL) and also to the national Next Generation Science Standards (NGSS) where appropriate. VSGC heavily integrates the elements of the *Profile of a Virginia Graduate* into all precollege programs. Virginia's state agencies see VSGC as a valued partner in STEM education, research and workforce development. VSGC Advisory Council and Board members keep the Consortium informed about state education and research goals and policy changes as well as member interests. VSGC leverages its extensive member and partner networks to stay abreast of changing policy landscapes.

Summary of Goals and Objectives

The proposed comprehensive project components and activities align with VSGC's strategic plan (Appendix A), state goals and priorities, NASA's 2018 Strategic Plan, NASA Mission Directorates, NASA Office of STEM Education (OSTEM), and NASA Space Grant goals. See the VSGC SMART goals summary matrix in Appendix B for more detail.
VSGC goals and objectives include the following: **Goal 1** - Conduct quality scholarship and fellowship programs including research awards for undergraduate and graduate students, a Bridge program for undergraduate students, and community college STEM scholarships. **1.A** Each academic year, award students in four categories with scholarships and fellowships. Students will be competitively selected by review panels consisting of representatives from member institutions. **1.B** Award at least the minimum funding as required by NASA in scholarship and fellowships to at least 60 students each academic year. **1.C** Each academic year, provide a percentage of awards to underrepresented minority and female students that is consistent with the diversity target as established by NASA (Currently 29.8%). **1.D** At least 90%

of students receiving research awards will attend and present at the annual VSGC Student Research Conference (SRC). **1.E** Longitudinally track 100% of all students receiving significant awards to identify their next step in academia or the workforce. **1.F** At least 60% of students receiving significant awards will be employed by NASA, an aerospace contractor, higher education or other educational institutions. **1.G** At least 45% of undergraduate students receiving significant support from VSGC will move on to advanced education in NASA-related disciplines in their next step.

Goal 2 - Offer quality higher education programs that align with NASA Mission Directorates including internships, student research experiences, and student flight and design projects in partnership with our member institutions and other partners. **Objective 2.A** Each academic year, provides paid internships for at least three students at NASA Centers or with industry partners. **2.B** As funding permits, continue to effectively manage the Commonwealth STEM Industry Internship program, placing at least 50 students in paid internships with Virginia companies each year. **2.C** Conduct at least one annual higher education project in partnership with Virginia's community colleges. **2.D** Each year, conduct at least two higher education projects in partnership with VSGC member institutions.

Goal 3 - Promote diversity in all programs and activities by encouraging participation of underrepresented minority and female students and faculty. **Objective 3.A** Each year conduct at least one outreach program or event with HBCU member Hampton University**. 3.B** Each year conduct at least one outreach event with a non-member MSI. **3.C** The percentage of all direct student awards will be made to at least 29.8% underrepresented minorities and 40% females. **3.D** Provide at least one STEM program each year for special needs faculty or students.

Goal 4 - Undertake programs that foster research capabilities at member institutions and serve as a catalyst for linking university researchers to NASA and other opportunities. **4.A** Conduct a New Investigator award program targeting tenure track faculty who are within the first five years of their academic career. At least four awards will be given, and the research will align with NASA mission directorates. **4.B** Disseminate at least 20 research opportunity announcements to statewide networks. **4.C** Facilitate at least five meetings with university researchers and NASA personnel, as appropriate, resulting in at least two collaborative proposals being submitted. **4.D** Support at least two experiential student research, mission and design programs.

Goal 5 - Provide quality precollege educational opportunities including professional development for precollege and pre-service educators and student-focused programs for students throughout the precollege pipeline. **5.A** VSGC will provide professional development in STEM and using NASA resources to at least 40 teachers each year. **5.B** VSGC will reach over 300 students by conducting selected student-focused programs and activities promoting participation in STEM and related careers. **5.C** At least 50% of all precollege students participating in VSGC-sponsored programs will express an interest in STEM careers.

Goal 6 - Conduct informal science education programs in partnership with informal education members and partners. **6.A** Sponsor at least one program with the Virginia Air and Space Center, Science Museum of Virginia, or other informal education partners to promote STEM each year.

6.B Consider other informal science education opportunities as funding and partnerships permit with the goal of sponsoring at least one other activity per year.

Goal 7 - Serve as an effective steward of Consortium resources and a strong partner for STEM programs by effectively leveraging NASA Space Grant resources. **7.A** Effectively leverage NASA Space Grant resources by three to one. **7.B** Network with other Space Grants and Space Grant organizations. **7.C** Network with NASA Headquarters and NASA Centers for program implementation. **7.D** Build and sustain effective strategic partnerships, including relationships with state and federal legislators and officials. **7.E** Number of program partners working with VSGC.

Goal 8 - Support national, regional and cross-cutting initiatives that align with NASA and Consortium goals as external funding permits.

Alignment with NASA and State Goals and Priorities

VSGC proposed projects and activities will help NASA to achieve its STEM Engagement vision to immerse students in NASA's work, enhance STEM literacy, and inspire the next generation to explore. Proposed projects include student-focused programs, educator professional development, faculty-mentored and NASA-related student research, and faculty-led research of interest to NASA. All proposed activities align with the NASA OSTEM cross-cutting design and operational principles and support OSTEM's objectives through implementation of projects that: provide mission-driven authentic STEM experiences; are based on research and best practices; focused on diversity and inclusion; and are scalable through partnerships and networks.

The mission of VSGC and the goal of all proposed projects directly align with NASA's Strategic Objective 3.3: *Inspire and Engage the Public in Aeronautics, Space, and Science*. VSGC projects will inspire, engage, educate, and prepare for employment the next generation of explorers through unique NASA-aligned STEM learning opportunities. VSGC projects also align with the goals, objectives, and three focus areas of NASA OSTEM by creating unique opportunities for students to contribute to NASA's work and research; by increasing the diversity of the STEM workforce through engaging and authentic experiences with NASA's people and facilities; and by strengthening an understanding of STEM through connections to NASA.

VSGC supports the overall goal of the Space Grant Program of contributing to NASA's mission in the area of government and industry partnerships that improve America's aerospace technologies and advance American leadership. VSGC works closely and directly with member institutions, partners, and stakeholders to provide programs that align with OSTEM goals and contribute significantly to the OSTEM Annual Performance Indicators (APIs). Through its comprehensive NASA Internships and Fellowships (NIF) program and other direct student support projects, VSGC will align with, and contribute to, NASA OSTEM Performance Goal 3.3.3. VSGC will provide opportunities for students to engage with NASA's aeronautics, space, and science people, content, and facilities in support of a diverse future NASA and aerospace industry workforce. In alignment with NASA API 18-1, significant, direct student awards in higher education will be provided to students from three targeted categories to increase the diversity of the STEM workforce. NIF and other direct student support and awards will be made to students from across all institutional categories and levels, to racially and ethnically

underrepresented students, and to female participants. VSGC will also support OSTEM Performance Goal 3.3.5 and API 18-5 by providing support and opportunities for students to contribute to NASA's missions in exploration and discovery. These projects will contribute to America's technical capability and result in multiple paper presentations and peer-reviewed research publications.

VSGC has a long and successful track record of meeting the goals and objectives of the NASA Space Grant program. The continuity of a full-time Director with nearly 30 years of experience plus her additional experience of leading NASA and STEM education programs allows VSGC to remain agile and effectively plan and implement programs. VSGC will continue to maintain an entrepreneurial approach to leveraging Space Grant funding to obtain other sources of external funds and support to develop and offer programs of interest to NASA. Significant cost-share (200%) to support a wide range of projects is proposed. VSGC also has strong partnerships with two NASA Centers as members to further support activities. Space Grant funding, direct cost-share funding, and other external funding will be managed and administered to impact the maximum number of participants in alignment with the seven Space Grant objectives. See Appendix C for a summary table of VSGC alignment with NASA mission directorates, NASA OSTEM goals, and Space Grant objectives.

VSGC works closely with state leaders in STEM education to meet state needs. The proposed VSGC projects align with the goals and recommendations from the 2017 Virginia Aviation and Space Career and Workforce Implementation Plan prepared by the Virginia Tech Office of Economic Development. VSGC Director Mary Sandy was a member of the Project Steering Committee which provided ongoing oversight and guidance to this plan's development. The Plan established three key Goal Areas for Virginia to improve in aerospace and aviation workforce development. The proposed VSGC programs align with and support all three key Goal Areas. Each Goal Area included recommended Strategic Actions to ensure goals are met.

The three Goal Areas are summarized as: 1) Promote visibility and importance of aviation and aerospace in Virginia through enhanced state-wide coordination; 2) Engage more Virginia K-12 students in classroom, informal education and experiential curriculum related to STEM, aviation and space through work experiences and flagship programming; and, 3) Develop stronger aviation and space industry talent pipelines of adult workers through outreach and training to support employer needs and high growth areas. Key Actors were identified in the Plan to lead the Strategic Actions and a timeline for each Action was established. VSGC is identified as a Key Actor in several of the Actions. A number of VSGC programs were identified in the Plan as best practice initiatives and align directly with the key Actions. This emphasizes the importance of VSGC's role, and the respect and value placed upon the Consortium in helping the Commonwealth meet STEM education and workforce goals.

VSGC's proposed precollege programs align with the Commonwealth's updated precollege STEM education agenda. Led by the VDOE, a Consortium member, the Commonwealth has focused on developing STEM-literate citizens necessary for success in any 21st century profession. Virginia STEM education efforts are targeting STEM literacy which includes components such as scientific method and discovery; technology as a tool to solve problems; engineering to design, test and solve a problem; and mathematics to quantify and evaluate the

problem and a solution's success. As students become STEM literate citizens, they need to have the foundational content and the discipline processes that allow them to make informed decisions concerning future STEM issues and technologies.

VSGC programs and activities are designed to prepare students to meet the requirements of VDOE's *Profile of a Virginia Graduate*. Key to the Profile is the consideration given to the five ***'C's'*** when developing education programs: critical thinking, creative thinking, collaboration, communication and citizenship. The Profile describes the knowledge, skills, experiences and attributes that students must attain to be successful in college and the workforce and to be 'life ready.' A life-ready Virginia graduate must:

- Achieve and apply appropriate academic and technical knowledge (content knowledge);
- Demonstrate productive workplace skills, qualities, and behaviors (workplace skills);
- Build connections and value interactions with others as a responsible and responsive citizen (community engagement and civic responsibility); and
- Align knowledge, skills and personal interests with career opportunities (career exploration).

VSGC Alignment with NASA Mission Directorates - VSGC seeks to support an interdisciplinary suite of research and programs aligned with all four of NASA's Mission Directorates. In support of the Aeronautics Research Mission Directorate (ARMD), VSGC will solicit and fund proposed research and support programs that align with the focus areas of ARMD: global operations; innovations in supersonic aircraft; ultra-efficient vehicles; low-carbon propulsion; safety assurance; and autonomy. Faculty at Consortium-member institutions include some of the most experienced and credentialed researchers in these areas in the nation. These faculty will be key contributors to the future workforce pipeline through the mentorship of student-led research. VSGC will seek research proposals in all four NASA ARMD programs including: Advanced Air Vehicles Program; Airspace Operation and Safety Program; Integration Aviation Systems Program; and, Transformative Aeronautics Concepts Program.

In support of the Human Exploration and Operations Mission Directorate (HEOMD), VSGC will seek research proposals and support programs in support of the human research program, space biology, physical science research, and engineering research. Research and technology development areas in HEOMD support launch vehicles, space communications, and the International Space Station. Research will be supported especially in areas such as solid fuels, complex fluids, fluid physics, fundamental physics, and materials science.

To support NASA's Science Mission Directorate (SMD), VSGC will support proposed student research and programming in the four areas of SMD research: Earth Science, Heliophysics, Planetary Science, and Astrophysics. VSGC-supported research will help NASA meet its science objectives to answer fundamental questions in the context of the national science agenda. Research that answers these questions will be emphasized by VSGC: What drives variations in the Sun, and how do these changes impact the solar system and drive space weather?; How and why are Earth's climate and environment changing?; How did our solar system originate and change over time?; How did the universe begin and evolve, and what will be its destiny?; and How did life originate, and are we alone?

VSGC-supported research and programming will align with two foundational Earth Science documents: National Research Council 2017 Earth Science Decadal Survey and NASA's Plan for a Climate-Centric Architecture for Earth Observations and Applications from Space.

To support NASA's Space Technology Mission Directorate (STMD) in developing crosscutting and new technologies needed by the agency to achieve its current and future missions, VSGC will seek to support STMD research and related programming in a variety of topics. VSGC-supported programs and research will align with NASA's goal to invest in bold, broadly applicable and disruptive technology to solve problems difficult to approach with today's technology. Current space technology topics of interest to NASA include, but are not limited to: advanced manufacturing in space; autonomous in-space assembly; ultra-lightweight materials; materials and robotics for extreme environments; deep space optical communication; advanced power generation; entry, decent, and landing systems; in situ resource utilization; radiation mitigation; and environmental control and life support systems

VSGC-supported research and programs will align with the goals and objectives contained in the 2015 NASA Technology Roadmaps. These 15 Roadmaps outline NASA mission capabilities and associated technology development needs. Consortium member institutions are well-poised to conduct research to generate innovative solutions for technology to support space exploration and scientific discovery. VSGC will seek student and faculty research proposals in support of the 15 distinct technology areas.

VSGC Programmatic Elements and Activities

VSGC NASA Internships and Fellowships (NIF) - With space grant funding, matching funding from the Commonwealth, and Consortium-member matching funding, VSGC supports student scholarships, fellowships, and internships. VSGC's support of NASA Internships and Fellowships (NIF) is an integral part of its mission. VSGC seeks to support an interdisciplinary suite of faculty-mentored student research and also support students from diverse backgrounds, academic levels, and majors to participate in real-world hands-on paid internships at NASA Centers and with industry.

VSGC Scholarship, Fellowship, and NASA Internship Program - VSGC offers four categories of scholarship/fellowship direct student awards and these will be continued for the 2020-24 award period. The four programs include: Graduate Research Fellowship program ($6,000 add-on fellowship; renewable for a second year); Undergraduate Research Scholarship program (up to $8,500 of one-year support for juniors/seniors); Community College STEM Scholarship program ($2,000 one-year scholarship); and Undergraduate STEM Bridge Scholarship program ($1,000 scholarships to students in their sophomore year; renewable for one year). Awards are for U.S. citizens and students enrolled full-time.

Though not included in VSGC certified match, member universities provide at least $6,000 in contributed funding for each fellowship. Through the State Council for Higher Education in Virginia (SCHEV), a Consortium-member, the Commonwealth provides $170,000 each year in support of scholarships and fellowships. This funding is used directly for student support and is not reduced by any administrative or indirect costs and is included as certified match.

In Year 1, VSGC will award $294,700 in scholarship and fellowship funding to an estimated 72 students ($124,700 from Space Grant and $170,000 from Commonwealth matching funds). VSGC will provide the following estimated direct student awards: $186,000 ($170,000 state, $16,000 Space Grant) to 31 Graduate Research Fellows; $73,700 to 11 Undergraduate Research Scholars; $10,000 to five community college scholars; and $25,000 to 25 STEM Bridge Scholars. In Years 2-4, VSGC will award $290,800 in funding ($120,800 from Space Grant and $170,000 from Commonwealth matching funds) to an estimated 71 students. VSGC will provide the following estimated direct student awards: $186,000 ($170,000 state, $16,000 Space Grant) to 31 Graduate Research Fellows; $69,800 to 10 Undergraduate Research Scholars; $10,000 to five community college scholars; and $25,000 to 25 STEM Bridge Scholars.

Research awards are faculty mentored and are awarded to students conducting research in support of research priorities in all four of NASA's mission directorates. VSGC-supported research experiences motivate and prepare students for careers in STEM in the aerospace sector with NASA, aerospace contractors or higher education. Traditional aeronautics disciplines, the Next Generation Air Transportation System, environmental science, global climate change, human exploration, and space technology will be of particular interest to the Consortium because of ties to NASA Langley and NASA Wallops. VSGC will actively solicit and fund research related to all four mission directorates.

All awards are competitively made through an online application and panel review process. Student applicants submit an online application including transcripts, research proposal and alignment with NASA mission directorate(s) (for the two research awards), interest in working in STEM, and two letters of recommendation. Only students from member institutions are eligible to apply for scholarships and fellowships. Research awardees are selected by a VSGC panel of reviewers consisting of one STEM faculty or administrative representative from each member institution. For the highly competitive research awards, internal review panels are conducted at each institution to identify the strongest applicants for full panel consideration. The five-member VSGC panel selects the final awardees from this pool of student research proposals. Selections are based on academic merit and the quality and strength of the proposed research and its alignment with NASA's mission directorates.

Community College scholarships are awarded by a panel of STEM faculty and representatives from member colleges. VSGC staff provides guidance to reviewers and coordinates the review panel meetings. Undergraduate STEM Bridge applicants are reviewed by VSGC staff and then competitively selected by a panel of reviewers at each member institution. Nominees for Bridge scholarship awards are forwarded to VSGC for approval. Panel members are diverse in terms of gender, race, ethnicity and academic backgrounds.

Diversity in NIF - VSGC is committed to diversifying the STEM workforce through recruiting and awarding a diverse population of students in terms of gender, race, and ethnicity. VSGC's diversity goals for awards to underrepresented minorities and female students align with the higher education enrollment percentage for Virginia per the National Center for Educational Statistics which is currently 29.8%. VSGC will award at least 40% of all direct student awards to female students. This target applies to all VSGC-supported students including scholarships, fellowships, internships and any students receiving direct monetary support. To help meet

diversity targets, VSGC has identified one point of contact at each member institution that assists the Consortium in networking with student minority groups and opportunities where VSGC staff can target underrepresented groups and female students with student award information and programs. Faculty mentors leading VSGC-supported NIF opportunities, higher education and research projects are encouraged to identify underrepresented and female students for participation in projects.

VSGC Support for NASA Center Internships - VSGC values student internships at NASA Centers and also at other STEM and aerospace organizations and industry partners as meaningful higher education experiences that prepare and motivate students for a career in STEM. VSGC's internship program aligns with **VSGC Goal 2** of offering quality higher education programs including internship programs in partnership with our member institutions and other partners.

In each year of the performance period, VSGC will sponsor one undergraduate student summer internship at a NASA Center selected through the NIF process. For NASA Center internship openings, VSGC markets the opportunity to all higher education institutions in Virginia. Promotion of NASA Center internships includes reaching out to non-member minority-serving institutions such as Norfolk State University and Virginia State University. VSGC actively seeks to fund underrepresented applicants and especially students for whom the Consortium has had previous interactions including precollege projects and other higher education programs. The selected intern will receive the standard stipend of $7,300 for the summer internship. VSGC will longitudinally track each intern to his/her next step. As other sources of funding become available, VSGC will support additional NASA Center interns as appropriate.

NASA Community College Research Experiences - As part of VSGC's goal to provide real-world research projects and summer experiences at NASA Centers, the STEM Takes Flight (STF) at Virginia's Community Colleges project was established through a previously awarded competitive Space Grant augmentation. VSGC has sustained this successful program through VSGC funding and support from the Virginia Community College System (VCCS). STF provides summer NASA research experiences for community college students at NASA Langley Research Center and Wallops Flight Facility (WFF).

NASA mentors work directly with VSGC to staff to develop and offer research opportunities that align with community college student majors and career paths. The program is open to students attending any Virginia community college. The online application selection and review process is facilitated by VSGC. Each year VSGC has budgeted $50,000 to support 10 student research experiences. In addition, the VCCS is underwriting an additional 15 research placements plus a tour of WFF for the Langley students for a total of $76,700 in cost share.

VSGC Programmatic Elements by Mission Directorate

The proposed array of VSGC programs aligns with all four mission directorates and projects are offered in a variety of different formats to reach a wide and diverse audience. See Appendix C for a summary of project alignment by mission directorate and NASA and VSGC goals. VSGC seeks to increase the capacity of all STEM stakeholders in the state and build partnerships and collaborations to support NASA's mission while meeting state goals in STEM education.

VSGC research infrastructure programs support efforts that build and develop the capacity of institutions for sustained capabilities in NSA-relevant research. VSGC seeks to advance Consortium member research capabilities by creating focused links between faculty-sponsored research within the Consortium and NASA needs via collaborative, mission-oriented projects, often with the involvement of our NASA members. VSGC serves as a catalyst connecting faculty with NASA researchers and facilitating networking and opportunities for collaboration. VSGC projects provide authentic experiences in science and engineering disciplines which are rooted in NASA-related, STEM-focused questions and issues and where students participate in real-life problem-solving as the context for activities. VSGC supports an interdisciplinary approach to research and seeks collaborative projects that cross departmental disciplines.

VSGC provides a suite of precollege programs for both students and teachers that align with NASA's mission directorates, promote STEM literacy and awareness of NASA's mission, and inspire and engage participants in STEM. For precollege programs, the VSGC offers several student-focused programs designed to increase enrollment and interest in STEM and professional development opportunities. Student-focused programs expose students to a range of NASA-related, experiences while engaging them with NASA and industry scientists and engineers. VSGC recruits precollege student applicants through an extensive statewide network and database of precollege contacts, including school systems and individual school contacts and the private and home school networks. Electronic communication and some school visits and conference presentations are used to recruit a diverse pool of applicants. Student eligibility criteria for most programs include: appropriate academic level for the program with an interest in STEM; U.S. Citizen and a Virginia Resident; Minimum GPA of 2.7; and internet and email access. Students are selected through a competitive review process coordinated by VSGC.

VSGC offers a diverse collection of higher education programs to provide authentic, hands-on experiences in multiple STEM disciplines to students and faculty. Higher education projects have a direct connection to NASA's mission directorates and research interests and incorporate real-life problem-solving interdisciplinary content as the context for activities. VSGC will continue to strengthen the institutional relationships with all institutions of higher education and community colleges in Virginia.

Aeronautics Research Mission Directorate Projects

Pathways Flight Academies (PFA) - With funding from the Commonwealth of Virginia, VSGC established the Pathways Flight Academies (PFA) project. PFA immerses students in learning to fly while discovering the range of exciting aviation career opportunities available. The demand for aviation jobs is extremely high. Sixty thousand new U.S. pilots will be needed in the next 15 years as well as 10,000 new U.S. air traffic controllers and 480,000 new aviation maintenance technicians worldwide by 2026. Averett University and Liberty University have partnered with VSGC to coordinate and host the academies. Both Virginia universities have outstanding facilities for aviation education and flight training and operate FAA-approved part 141 flight schools. Four, two-week residential academies are offered during the summer for selected students who have shown an interest in STEM and have career aspirations to become a pilot. Students admitted to this intensive program participate in ground school and flight training that can culminate in their first solo flight at the end of the academy.

PFA is a rigorous program in which students immerse themselves in learning about weather, electronic navigation, flight systems and operations, and FAA regulations. The competitive application process is open to students statewide. Qualified applicants must be U.S. citizens, Virginia residents and 16 years old by the start of the Academy. They must also be able to pass an FAA flight physical exam upon acceptance into the program. Twenty-four students will be selected to participate in each year. A total of $100,000 in Commonwealth funding in each year is being contributed as cost-share to enable the PFA program.

Aerospace Day in the Commonwealth - In each year, VSGC will participate in the annual Aerospace Day at the General Assembly event. This two-day event brings together Virginia's extensive aerospace community including representatives from the two NASA Centers to raise awareness of the importance of the aerospace and aeronautics sectors to the Commonwealth. VSGC informs state legislators about the value of NASA and VSGC education and STEM engagement programs. The VSGC Director is a key member of the event leadership team and leads the aerospace sector messaging for both NASA and industry. VSGC Director and other staff attend meetings with state lawmakers and also typically invite former student awardees and program participants to attend the meetings. VSGC also features an exhibit at a reception that kicks off the annual event. A total of $1,500 has been budgeted each year to partially cover the expenses needed to participate in this event.

Engineering Early Advantage Program for Women (EEAP) - EEAP is offered by Old Dominion University (ODU) for female engineering majors prior to their freshman year in college. VSGC has supported this project since its inception in 2001 and has budgeted $10,000 in each year to support the 15 student scholarship stipends and other program costs. EEAP consists of four weeks of academic- and career-enhancing activities in a unique engineering setting. Hosted by the ODU Batten College of Engineering and Technology, students will rotate through five engineering departments undertaking project-based learning and interacting with faculty and professionals. Field trips to local industry, on-campus speakers, and STEM career awareness and planning activities are also incorporated. Many of the projects support NASA's ARMD research but engineering projects and applications are very often very interdisciplinary and cross-cutting to all NASA research areas especially STMD. EEAP students are typically engaged in engineering activities aligned with ARMD in areas such as innovations in aircraft, designing low-emission vehicles, and airspace operations and safety among other types of projects. ODU longitudinally tracks all students to their next step and provides data to VSGC. VSGC partners with ODU assess the effectiveness of the program each year.

For the Airport Cooperative Research Program of the Transportation Research Board of the National Academies, VSGC manages two programs: ACRP Graduate Research Awards which provides ten mentored graduate research awards nationally, and the ACRP University Design Competition for Addressing Airport Needs which solicits student-designed solutions to airport and National Air System issues. As these programs are externally funded with FAA dollars through the ACRP, they are not included in our budget request to NASA.

Human Exploration and Operations Mission Directorate (HEOMD)

Virginia Aerospace Science and Technology Scholars - VSGC created and manages the Virginia Aerospace Science and Technology Scholars (VASTS) program in partnership with Consortium-

member NASA Langley, and with funding from the Commonwealth and industry. VASTS is a competitive statewide program that allows more than 500 Virginia high school juniors and seniors to take an engaging online NASA-developed course that uses a space and Mars exploration theme to teach a broad range of STEM skills that are aligned with Virginia SOL. Successful scholars in the online course, 180 each year, may participate in one of three all-expense paid, seven-day residential academy at NASA Langley where they collaborate in teams to complete a systems engineering design project to develop a human mission to Mars. The students receive three college credits for completion of the online coursework and an additional two college credits for attending the Summer Academy through Thomas Nelson Community College (TNCC). NASA Langley employees serve as mentors and master teachers facilitate the coursework and the Academy. Students are tracked for six years following participation and the program is externally evaluated. The Commonwealth funds VSGC to manage VASTS and all student costs. Support of $319,300 in year 1 and $295,300 in years 2-4 is being contributed as cost-share to support the project. NASA Langley also supports the program.

Science Mission Directorate (SMD)

Virginia Earth System Science Scholars - Based on the successful model of the VASTS program, VSGC developed and offers the Virginia Earth System Science Scholars (VESSS) program to engage students in real-world investigations of the Earth and its highly dynamic systems through the use of the latest NASA and NOAA research and data. VESSS provides a one-semester online course for high school juniors and seniors. High performing students are invited to a one-week residential summer academy at NASA Langley. About 180 students participate in the online program and an estimated ninety students will attend one of two academies hosted by NASA Langley. The content of the online course and the summer academy align with the National Research Council's 2007 Earth Science Decadal Survey. College credit is available through TNCC for both the online course (four credits) and the summer academy (one credit).

VESSS is a partnership with NASA Langley, Hampton University's Center for Atmospheric Research and Education, and TNCC. Partial funding is provided through a NASA MUREP Grant to Hampton University supporting online course delivery in Year 1. Annual Commonwealth cost share of $50,000 is included in the budget.

Building Leaders for Advancing Science and Technology - VSGC created and offers the Building Leaders for Advancing Science and Technology (BLAST) program for ninth- and tenth graders statewide. Supported with funding from the Commonwealth of Virginia, the program has provided hands-on STEM activities at the University of Virginia (UVA), Virginia Tech, and ODU to more than 2,000 Virginia high school rising freshmen and sophomores statewide since 2013. Offered free of charge, BLAST provides a three-day, on-campus residential summer program designed to bring STEM alive through a series of innovative, hands-on experiences facilitated by university faculty, students and staff. Up to 320 students participate in four annual BLAST sessions hosted by member institutions. BLAST has an internal summative and formative evaluation process. The project is funded with state funds of which $100,000 is included annually as matching funding.

BLAST content varies by host institution but includes SMD topics such as climate change, Earth and environmental science, sensing and measuring the environment, forensics, and other similar

areas of science of interest to NASA. BLAST is also cross-cutting among other mission directorates including Space Technology and Human Exploration with activities in robotic exploration on the moon and Mars, engineering design and testing, using small satellites, and operating drones.

Space Technology Mission Directorate (STMD)

Community College Faculty Professional Development Workshop - Since 2015, VSGC has coordinated and offered a professional development workshop for community college STEM faculty in partnership with NASA Wallops. VSGC and NASA Wallops continue to partner to provide the annual workshop and funding is provided by the Consortium through its state funding with NASA WFF contributing content and hosting the workshop site. Faculty receive hands-on training and work in teams on projects centered around NASA missions. Faculty participate in simulated NASA mission activities such as launches and airborne and other missions. In addition to STEM content, they learn about NASA's mission management and the integration of STEM skills in NASA projects. VSGC will offer this workshop for at least 20 community college faculty in each year of the period. Annual cost share of $20,000 will be provided by the Commonwealth. VSGC staff coordinate and manage the program.

Virginia Space Coast Scholars Program (VSCS) - VSGC created and offers the Virginia Space Coast Scholars (VSCS) program for current high school sophomores statewide. Participating students focus on the science, engineering, and technology integral to current missions at NASA WFF and the Mid-Atlantic Regional Spaceport. This hybrid program is free to students and inspires those who possess technical and scientific interests and are motivated to learn about the many different opportunities that NASA offers. The program features two key elements: a dynamic on-line STEM learning experience featuring five modules (400 students); and, three seven-day residential Summer Academies (120 students total) at NASA WFF where scholars learn directly from NASA professionals and their partners about the latest, cutting edge technologies and missions. The VSCS program is a partnership between the VSGC, NASA WFF, the Mid Atlantic Regional Spaceport, and the Commonwealth of Virginia. An annual cost share of $100,000 is provided by the Commonwealth of Virginia.

VSGC Competitive Projects

Commonwealth STEM Industry Internship Program - Since 2013, VSGC has conducted the Commonwealth STEM Industry Internship Program (CSIIP) with support from the Commonwealth of Virginia. CSIIP provides an online application, review and selection process through which undergraduate students attending institutions in Virginia can apply for fall, spring, and summer paid internships with industry in Virginia. The program is managed and coordinated by VSGC. More than 200 companies are currently registered, and 580 students have been placed since inception. At no direct cost to Space Grant, VSGC will place at least 50 students in industry internships in each year of the performance period. All internship placements will align with NASA mission directorates and it is anticipated that placements will be made that align in all four areas. Sustained Commonwealth funding to operate and manage the program and administer the online application and review process will be provided throughout the award period. Annual State cost share is $100,000.

New Investigator Program - VSGC will continue to offer the New Investigator Program (NIP) designed to strengthen Virginia's research infrastructure by providing startup funding to member university faculty in the first five years of their academic careers who are conducting research directly aligned with NASA's mission directorate priorities. The program responds to the NASA emphasis in targeting early career faculty to focus their research toward NASA priorities. In each year, VSGC will provide four or five NIP awards at $10,000 each to faculty. Universities contribute equal funding which is not included in VSGC's certified match to NASA.

VSGC will identify a panel of reviewers that will include Consortium-member tenured faculty, NASA Langley personnel, and other representatives to conduct a competitive review of faculty proposals. Awardees will be selected based on the quality and merit of the research plan and its alignment with NASA's mission directorates and Space Grant and NASA research priorities. Other factors in considering funding for research will include the alignment of the proposed budget with the plan, the compelling case for the need for the research to further support the investigator's career, and a letter of support from a research colleague.

Student Research Conference - VSGC conducts an Annual Student Research Conference and Luncheon that is sponsored by VSGC university presidents in honor of all current VSGC scholars, fellows and all alumni. Participation and a presentation by all research scholars and fellows are requirements of the award. Graduate Fellows present 15-minute oral presentations while Undergraduate Scholars present poster sessions. STEM Bridge Scholars and Community College Scholars are provided with a half-day session targeted specifically toward NASA research that helps the students network with role models representing NASA's diverse underrepresented minority workforce. NASA personnel, faculty, advisors, and business/industry representatives attend the conference and interact with the student presenters. Space Grant funding of $4,000 in each year is budgeted for the conference. An estimated 175 people will attend the conference and luncheon. Post-event assessments will be administered by VSGC to evaluate the conference.

Student Flight and Design Programs - VSGC is budgeting $40,000 in years 1-2, $33,780 in year 3 and $31,446 in year 4 to support competitively selected student flight programs. The RockOn! sounding rocket workshop at NASA WFF, a VSGC/Colorado Space Grant partnership, involves more than 50 faculty and students from across the country in a hands-on workshop to develop a scientific payload to be launched on a sounding rocket. VSGC typically provides support to participating teams from member universities as well as to the follow-on project, university developed RockSat payloads. VSGC will also provide administrative and staff support to the RockOn! project each year.

VSGC will continue to support CubeSat and ballooning initiatives as well as design projects that align with all four mission directorates. The VSGC has an active Small Sat Working Group of interested member representatives which helps determine the focus for VSGC student flight projects and allocation of available funds. VSGC leads a statewide Small Sat Virginia Initiative with the five Space Grant universities, 15 Virginia companies, NASA Centers and other organizations as members. The goal is to facilitate collaborations along NASA, university and universities for small satellite activities and to promote economic growth in the Commonwealth.

Innovative Projects Fund - VSGC will continue to support competitively selected innovative projects submitted by Consortium members. These projects will align with NASA mission directorates, VSGC's strategic plan, and state goals and priorities. VSGC will identify and coordinate a panel of reviewers representing NASA and Consortium members to competitively select winning proposals. Projects that support interdisciplinary collaboration, educator workshops, student and faculty research, and other NASA-aligned programs will be considered priorities for funding. Successful project proposals will demonstrate innovation, alignment with VSGC and NASA goals, and include demonstrable outcomes and discernable outputs. VSGC will evaluate the project by requiring awardees to submit progress and annual reports and will conduct follow-up surveys of participants. A total of $15,248 is budgeted in year 1 and $14,323 in year 2 of the performance period.

Virginia Geographic Information Systems Poster Contest - VSGC proposes to continue to provide the cash prizes to the winners of the poster contest coordinated by Virginia Tech during their annual Office of Geographic Information Systems and Remote Sensing Symposium. Higher education students present their research and geospatial related projects during the annual poster competition. Projects target climate change and Earth and environmental science. Students develop informative graphics and posters on issues related to lidar, geospatial data and other remotely sensed data. Space grant funding of $500 is budgeted to award first place ($250), second place ($150), and third place ($100) cash prizes to students. Winners are selected by a panel of subject-matter experts who serve as competition judges.

Informal Education Programs - VSGC will coordinate a competitive proposal process to support informal education member institutions to offer programming in alignment with NASA's missions. NASA Langley's official visitor center, the Virginia Air and Space Center, the Science Museum of Virginia, and the MathScience Innovation Center will be invited to submit proposals for funding to support educator professional development, student programs, and other education and outreach activities. VSGC will solicit proposals that align with all four mission directorates and integrate NASA education and outreach materials. A total of $10,000 is budgeted to support these projects in year 1 of the performance period.

Program Assessment

In alignment with its strategic plan (Appendix A), NASA Strategic Plan, and NASA OSTEM and Space Grant goals, the VSGC has established goals, objectives, and indictors of success (performance metrics) across the four-year performance period. VSGC has also established impact target numbers as appropriate and set a target date for accomplishment of each project. The VSGC SMART matrix summarizing this information can be found in Appendix B. A milestone chart with annual deadline dates for project completion by month is included as Appendix D.

The VSGC program assessment plan supports VSGC's goal of continuous improvement and also supports NASA's Learning Agenda and Agency and OSTEM performance and evaluation priorities and requirements. VSGC collects performance and impact data to help monitor and assess the Consortium's performance and effectiveness of its investments. VSGC will provide data through annual reports, OEPM, and as requested to support NASA's OSTEM Performance

and Evaluation Model including NASA's goal of collecting data to make evidence-based programmatic decisions and to establish future performance measures.

For all scholarships, fellowships, and internships, VSGC will collect student information and obtain the necessary approvals at the institutional level to fulfill all grant reporting requirements for OEPM and other data requests as appropriate. The STF and CSIIP programs include evaluation assessments completed by students and research mentors which are evaluated by VSGC to discern effectiveness of the program, for continuous improvement, and to gather outcomes and impact. All students participating in VSGC's NIF programs are reported in OEPM and longitudinally tracked to their next step. VSGC collects data from all direct student award applicants regarding academic level, race, ethnicity, gender, disability status, and state and Congressional districts. This data helps the Consortium determine impacts on underrepresented populations and is reviewed regularly to improve VSGC's ability in meeting diversity goals and other targets per API 18-1.

Students receiving research scholarships and fellowships are evaluated through their presentations at the Annual Student Research Conference and the submission of a final research paper approved by their mentor. VSGC collects data from all students with research awards about their contributions to their areas of research through paper presentations and peer-reviewed research publications per API 18-5. Students in the Community College and STEM Bridge scholarship programs are evaluated through submission of a final report and by attending and participating in the SRC. VSGC tracks 100% of direct student awardees receiving $1,000 or more in funding as significant awards.

In each project, VSGC will implement mechanisms to evaluate impact in alignment with NASA goals and objectives and the Learning Agenda. Through post-event surveys and longitudinally tracking students and teachers, VSGC will be able to both quantitatively and qualitatively demonstrate increased enrollment and interest in STEM careers and educators use of NASA materials following professional development. Evaluation elements and methods vary by type of program. For all projects, VSGC collects data to determine impact, performance based on targets and metrics and alignment with NASA goals. For precollege programs, VSGC typically includes pre- and post-assessments as well as internal and external evaluations that allow for continuous program improvement. Evaluation approaches are both summative and formative.

VSGC uses both internal and external evaluation for program components. VSGC has a centralized data collection system for programs and works closely with member institutions and partners to gather required data for annual performance reports, the longitudinal tracking and student data tables, expenditure summaries, and the annual OEPM report. Longitudinal tracking for students receiving significant awards is accomplished through a biannual survey. VSGC actively uses social media platforms such as Facebook and LinkedIn as needed to update contacts for students.

Budget Statement

VSGC is providing 200% of the matching funds required for this proposal resulting in Consortium administrative costs of 22% to just under 25% over the four-year performance period.