A. PROGRAM DESCRIPTION

The National Space Grant College and Fellowship Program consists of 52 state-based, university-led Space Grant Consortia in each of the 50 states plus the District of Columbia and the Commonwealth of Puerto Rico. Annually, each consortium receives funds to develop and implement student fellowships and scholarships 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 the state’s interests. Although it is primarily a higher education program, Space Grant programs encompass the entire length of the education pipeline, including elementary/secondary and informal education. The New York Space Grant Consortium is a Designated Consortium funded at a level of $760,000 for fiscal year 2016.

B. PROGRAM GOALS

The New York Space Grant (NYSG) Consortium aims to inspire, engage, and educate students in science, technology, engineering, and math (STEM) disciplines, and to prepare students across NY State to be the future workforce for NASA and high-technology industries.

NYSG Goal #1: Our NASA Education Outcome 1 (Fellowship/Scholarship, Higher Education, and Research Infrastructure Programs) programs will positively impact the diversity of students entering the STEM workforce and pursuing advanced STEM degrees.

SMART Objective 1 – The percentage of NYSG underrepresented minority student awardees (monetary and non-monetary) per budget year shall meet or exceed the minority enrollment percentage in NY higher education institutions (33.4%). Statistics published in the National Center of Education Statistics (NCES) Digest (NCES Table 306.60: Fall enrollment in degree-granting postsecondary institutions, by race/ethnicity of student and state or jurisdiction: 2014 (https://nces.ed.gov/programs/digest/d15/tables/dt15_306_60.asp) are used as the benchmark for this objective.

SMART Objective 2 – The percentage of NYSG female student awardees (monetary and non-monetary) per budget year shall meet or exceed 38%. For this benchmark, data from the

**NYSG Goal #2:** Our NASA Education Outcome 1 (Fellowship/Scholarship, Higher Education, and Research Infrastructure Programs) programs will positively impact the **number** of students entering the STEM workforce and pursuing advanced STEM degrees.

**SMART Objective 3 – NYSG shall strive for 90% or more of graduating significant awardees to take the next step to STEM employment or STEM advanced.** Our progress toward this objective will be measured by data obtained from annual polling of significant student awardees’ current status/progress, based on the NASA HQ guidelines on longitudinal student tracking.

**NYSG Goal #3:** Our consortium will help build NY State higher education-industry collaborations, while assisting with high technology workforce development to decrease the “brain drain” afflicting NY State.

**SMART Objective 4 – NYSG shall add 2-3 more industrial affiliates in New York State by the end of the 2015-18 grant period.** Lockheed Martin and Moog Inc. were our only industrial affiliates at the beginning of this grant period. We aim to form mutually beneficial relationships with other major science and engineering companies that conduct diverse STEM research & development. This will help increase the number of students engaged in aerospace and NASA-related internships with New York State industries. Internships are a pipeline for industry to recruit and retain future scientists and engineers.

C. PROGRAM/PROJECT BENEFITS TO PROGRAM AREAS

**Example of NYSG benefit to NASA Internships, Fellowships, and Scholarships Program Area:**
Cornell University created a unique CubeSat summer 2016 internship opportunity open to all New York students to apply. One graduate and seven undergraduate students were competitively selected for internships funded by NYSG, joined by two undergraduate students selected and funded by Oregon Space Grant Consortium. These 10 interns had 10 weeks and roughly $10,000 to build a 10 cm satellite based on a NY high school student’s proposed design (winner of Museum of Science Fiction’s international CubeSat competition). They built and tested a CubeSat capable of deploying a super-thin, 4 square-meter sail in space, controlled by a tiny spacecraft-on-a-chip. We hope to launch this as part of NASA’s CubeSat Launch Initiative.

**Example of NYSG benefit to Research Infrastructure/Higher Education Program Area:**
A Colgate University undergraduate student presented the results of his Space Grant-supported research at the January 2017 meeting of the American Astronomical Society. He reported optical observations made at the Colgate Foggy Bottom Observatory and correlated them with gamma-ray observations made with NASA’s Fermi Gamma-ray Space Telescope. While at the meeting,
he worked with several NASA Goddard scientists to learn how to further analyze the gamma-ray observations, and is continuing his work this spring.

**Example of NYSG benefits to Informal Education Program Area:**
New York Space Grant supported Family Astronomy Nights at our new informal education affiliate, the Intrepid Sea, Air & Space Museum located in New York City. These free events featured high-profile speakers, such as former astronaut Tom Jones and the Juno mission’s principal investigator Scott Bolton, who engaged the audience in the marvels of space research. Presentations were followed by hands-on stargazing on the flight deck if weather permitted. This program served over 2,400 people ranging in age from toddler to senior.

**D. PROGRAM ACCOMPLISHMENTS**

a) NASA Internships, Fellowships, and Scholarships (NIFS):

Space Grant scholarships were awarded to CUNY City College of New York undergraduate students researching the effect of mechanical loading on bone maintenance, a topic of considerable interest to NASA for long-duration spaceflight. NIFS were also awarded to CUNY Medgar Evers College undergraduates engaged in research on Mars weather seasonality, newly discovered chemical reactions affecting North American air quality and climate, and developing a framework for CubeSat autonomic computing. University at Buffalo awarded NIFS to undergraduate and graduate students engaged in a variety of engineering projects, including design of a self-adjusting active suspension for planetary rovers; investigation of chemical-based, high energy density batteries; and development of space charge within dielectric polymer composite materials. Stony Brook University supported an undergraduate student’s research on direct methanol fuel cells. Syracuse University supported undergraduate summer intern’s research in environmental sciences. Union College supported undergraduate summer research on a variety of topics in physics, astronomy, biology, mechanical engineering, and computer science. A recent participant in the NYSG Community College Partnership Program transferred to CUNY York College to complete his bachelor’s degree; awarded NIFS support, he worked in York’s particle physics lab to prepare detector hardware for the Fermilab Mu2e experiment.

Space Grant fellowships were awarded to graduate students studying mechanical engineering and applied mathematics at Clarkson University, a graduate student implementing a novel approach to characterizing planet-hosting stars at Columbia University, graduate students in mechanical & aerospace engineering and astronomy at Cornell University, a Rensselaer Polytechnic Institute graduate student investigating a method to quantify the amount dark matter in dwarf galaxies, students in Rochester Institute of Technology’s Astrophysical Sciences and Technology Graduate Program, a Binghamton University graduate student developing new lightweight and high-strength aerospace engineering materials, and a CUNY graduate student who analyzed data from NASA’s Fermi Gamma-ray Space Telescope and successfully defended his PhD dissertation in December 2016.
NYSG sponsored four students’ summer 2016 internships at NASA Robotics Academy at Marshall Space Flight Center and NASA Goddard Institute for Space Students. These interns worked directly on projects such as EDUARDO (Electrostatic Detainment Unit for Automated Removal of Debris in Orbit), prototype of an extreme ultraviolet coronagraph designed for deployment on the International Space Station, and analyzing performance of various climate models in comparison with observed data.

Seven engineering students completed NYSG-funded summer internships at Lockheed Martin in Owego, NY, Moog Space and Defense in East Aurora, NY, and new NYSG affiliate Ursa Space Systems in Ithaca, NY. The Lockheed Martin interns worked as a team to develop a dual quadcopter system capable of designating a specific location and delivering a payload to it. The three undergraduates, studying different engineering disciplines, gained valuable experience with systems engineering and product development processes. Moog interns worked on projects such as re-designing circuitry for an in-house testing platform, determining methods for calculating and identifying out-of-family conditions for quality control, and designing and testing a prototype valve that may become flight hardware. The Ursa intern worked on SAR (synthetic aperture radar) satellite development.

Cornell University created a unique CubeSat summer 2016 internship opportunity open to all New York students to apply. One graduate and seven undergraduate students were competitively selected for internships funded by NYSG, joined by two undergraduate students selected and funded by Oregon Space Grant Consortium. These 10 interns had 10 weeks and roughly $10,000 to build a 10 cm satellite based on a NY high school student’s proposed design (winner of Museum of Science Fiction’s international CubeSat competition). They built and tested a CubeSat capable of deploying a super-thin, 4 square-meter sail in space, controlled by a tiny spacecraft-on-a-chip. We hope this will be launched as part of NASA’s CubeSat Launch Initiative.

b) Higher Education projects:

Colgate University utilized Space Grant funds to support undergraduate students’ astronomy research and conference travel. At CUNY Medgar Evers College, students majoring in computer science and environmental science collaborated on Earth science experiments using BalloonSats.

This year’s Augmentation funding allowed the revival of NYSG’s program to competitively award research initiation and STEM curriculum enhancement grants. Faculty members from all NYSG affiliate institutions were eligible to apply; grants were awarded in January 2017. NYSG’s support of “The CubeSat Initiative: An Effort to Cultivate an Experiential Learning-Based Aerospace Program” will help kick start a new CubeSat team at Columbia University. A project titled “Space Technology and Society: Space Studies Curriculum” will create new courses at Stony Brook University that cover the space program’s history, evolving issues and policies such as commercialization, and complex interactions between technology and society. By learning these foundational aspects, students will be better prepared to contribute to future space exploration.
Augmentation funding also allowed NYSG to set aside funds specifically for supporting student project teams, competitions, and other NASA-related efforts at NY schools and institutions, as part of a new Opportunity Grants program. This program helps to more equitably handle increasing numbers of ad hoc requests for funding, often from non-affiliates and schools, through a timely process. Full-time students and faculty at any accredited NY higher education institution, plus STEM teachers at any K-12 school within NY State, are eligible to apply. So far two cycles of Opportunity Grants have been offered. Grants were competitively awarded to a CUNY York College student team competing in the 2017 NASA Robotic Mining Competition, a Columbia University project to train NYC public school teachers on making astronomical observations with their students, and a Fairport High School science class and club participating in the HUNCH (High Schools United with NASA to Create Hardware) program.

On October 6-7, 2016, NYSG hosted the Northeast Regional Space Grant Meeting in New York City. Space Grant students and consortium personnel presented their research and special projects. Matthew Pearce, Education Officer for NASA Goddard Institute for Space Studies (GISS), gave an overview of GISS research and discussed collaborative opportunities with higher education. The CUNY Medgar Evers College NYSG affiliate director and her students provided special tours of CubeSat, BalloonSat, and other laboratories on their Brooklyn campus.

c) Research Infrastructure projects:

Undergraduate student researchers at Alfred University analyzed astronomical photometry data that contributed to the Center for Backyard Astrophysics and the Minor Planet Center. Barnard College undergraduates conducted research on classifying images from ground-based gamma ray telescopes and oxidative/ferromagnetic properties of semiconductor monolayers. Cornell University undergraduates designed and manufactured hardware in preparation for a Flux Pinned Orbiting Sample microgravity flight. Space Grant-supported research into advanced control technology and mechatronics continued at New York University’s Mechatronics, Controls, and Robotics Laboratory. SUNY Geneseo undergraduates conducted summer research projects in observational astronomy (photometric study of open cluster M48) and physics (cavity ringdown spectroscopy). At the University of Rochester, research continued on two Space Grant-supported projects: development of long wave infrared detector arrays for space applications (including the proposed NEOCam to discover near-earth asteroids), and the development and characterization of terahertz sensor arrays.

d) Precollege projects:

NYSG-funded undergraduates provided instruction during daytime laboratory activities and evening observing for Alfred University’s summer 2016 High School Astronomy Institute. CUNY Medgar Evers College required its Space Grant-funded students to participate in K-12 outreach, such as robotics workshops. Space Grant-supported students at New York University taught robotics-centered professional development workshops for
NYC-area teachers. They also mentored five high school students who conducted applied mechatronics research projects at NYU during summer 2016. University at Buffalo’s (UB) Space Grant fellows assisted with precollege activities such as teaching in-classroom science lessons at Westminster Community Charter School as part of a UB-National Grid partnership. Primary and secondary school teachers attended workshops at the Museum of Science and Technology (MOST) to learn concepts in rocketry, thermodynamics, energy transfer, and robotics. Participating teachers used the training and knowledge to guide their student teams enrolled in science & engineering competitions run by MOST, partnered with NYSG affiliate Syracuse University. Space Grant funds supported the ninth annual Physics Constants Workshop at Union College, during which high school physics teachers and students conducted hands-on experiments.

NYSG Opportunity Grants have provided materials and supplies for a Fairport High School teacher and students participating in HUNCH (High Schools United with NASA to Create Hardware) in addition to astronomy hardware for a Columbia University project to train NYC public high school teachers.

e) Informal Education projects:

NYSG-funded undergraduates conducted public outreach activities during observatory open houses at Alfred University. Undergraduate students presented public shows and gave sky talks to K-12 and civic group visitors at Colgate University’s Ho Tung Visualization Laboratory. NYSG funding provided valuable support of Columbia University’s Department of Astronomy outreach coordinator, who organized graduate students, post-docs, and faculty to provide a plethora of educational events at Rutherford Observatory and all around Manhattan and surrounding boroughs. Examples of Columbia’s many events supported this period: an annual Spanish-language astronomy lecture was conducted to foster connections with the Spanish-speaking community, and collaboration continued with the GOALS for Girls summer camp hosted by the Intrepid Museum. New York University’s NYSG affiliate director and students exhibited their robotics projects at many expositions, including the fourth US National Science and Engineering Expo in Washington, DC. University at Buffalo’s NYSG affiliate director and students engage with the community through programs such as running workshops in a Tech Savvy STEM career conference for middle school girls, and demonstrating UB’s RASCAL Robo-Ops entry at the Buffalo Museum of Science. Space Grant funds supported outreach programs conducted by Union College’s Society of Physics Students.

Syracuse University utilized Space Grant funds to partner with the Museum of Science and Technology (MOST) for the following science & engineering competitions in central NY: Rocket Team Challenge, Steamboat Challenge, Bridge Build’em and Bust’em, and a regional VEX Robotics Challenge. These competitions engaged more than 1,300 students in grades 4-12 in Syracuse and beyond; approximately 50% were from underrepresented groups. Informal education affiliate the Sciencenter continued to raise awareness about NASA’s mission and increased STEM literacy in Ithaca and surrounding rural areas through community outreach events and school visits. During Family Science Nights, participants engaged in hands-on space and earth science activities, as well as explored the
night sky in the Sciencenter’s StarLab portable planetarium. The planetarium was also utilized during presentations at elementary schools. So far 758 elementary students and families have participated, mostly from rural upstate NY areas.

We are pleased to announce the addition of a new informal education affiliate to our consortium: the Intrepid Sea, Air & Space Museum, located on the USS Intrepid aircraft carrier docked off Manhattan. Space Grant funds were used to support four Family Astronomy Nights, during which high-profile speakers introduced children and parents to fascinating space-related topics in approachable and engaging ways, followed by hands-on stargazing on the flight deck if weather permitted. These events featured talks on the IceCube Neutrino Observatory located in Antarctica by Dr. Naoko Kurahashi, how radio telescopes enable scientists to unlock secrets of the universe by Summer Ash, and never before seen images from the Juno Mission (principal investigator Scott Bolton gave his talk a mere eleven days after Juno arrived at Jupiter). Former astronaut Tom Jones reflected on his experiences in space and emphasized that children in the audience could be the first humans to set foot on Mars. This new program served over 2,400 people ranging in age from toddler to senior.

E. PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE GOALS

Include summary data for the bulleted list below:

- **Diversity**: Diverse institutions comprise the NY Space Grant Consortium: higher education institutions that are public and private, small and large; informal education/non-profit organizations; and industry. Space Grant programs at affiliate institutions, spread throughout upstate NY and the New York City area, are led by affiliate directors (faculty and professionals) from many different STEM fields. Nine of the twenty-three (39%) NYSG affiliate directors are women (not including the associate director at the lead institution). Diversity of student participants is the primary aim of NYSG’s SMART Objectives #1 and #2.

- **Minority Serving Institution Collaborations**: Three NYSG affiliates are minority-serving institutions: CUNY City College of New York, CUNY Medgar Evers College, and CUNY York College. While Stony Brook University is not a minority institution, NYSG is partnered with its Louis Stokes Alliance for Minority Participation (LSAMP) program to support NASA-related research opportunities for minority students.

- **Office of Education Annual Performance Indicators**:
  - API 2.4.1: ED-16-1  46 (Number of NIFS/significant awards to higher education students who are racially or ethnically underrepresented, women, persons with disabilities, or veterans so far.)
  - API 2.4.2: ED-16-2  180 (Number of educators who have participated so far.)
API 2.4.4: ED-16-4  STEM strategic partnerships were maintained between NYSG and three informal education institutions: the Sciencenter in Ithaca; Museum of Science & Technology (MOST) in Syracuse; and the Intrepid Sea, Air & Space Museum in New York City. Refer to the Program Accomplishments/Informal Education section above for more details.

API 2.4.5: ED-16-5  6,096  (Number of elementary and secondary students who have participated so far.)

F. IMPROVEMENTS MADE IN THE PAST YEAR
Two new affiliates were added to the NY Space Grant Consortium: the Intrepid Sea, Air & Space Museum, a museum located on the USS Intrepid aircraft carrier docked off Manhattan, and Ursa Space Systems, an aerospace start-up company in Ithaca that specializes in satellite imagery. Intrepid Museum helps us reach a wider audience in the diverse and densely populated NYC area, while adding Ursa is progress towards NYSG’s SMART Objective 4. A new Opportunity Grants program was instituted to more equitably handle increasing numbers of ad hoc funding requests from full-time students, faculty, and teachers across NY State (not limited to affiliate institutions). NYSG Consortium (@NYSpaceGrant) is now on Facebook & Twitter – we aim to post/tweet at least once per weekday on Space Grant plus other NASA and STEM opportunities and announcements of interest.

G. CURRENT AND PROJECTED CHALLENGES
Due to the delay in NASA’s official authorization at the beginning of NYSG’s 2015-18 award, some affiliates were unable to provide support as planned for Year 1 students; NYSG support of summer 2015 NASA and NY industry interns during Year 1 was also impeded. The ability to carry over into the current Year 2 has been very helpful for expending funds and timely student support. NYSG experienced challenges with the summer 2016 NASA intern placement/support processes, such as not being notified when students to be funded by NYSG were extended offers by NASA, not knowing whether they accepted or declined offers, and additional burden imposed by ranking multiple rounds/lists of students selected by NASA mentors.

H. PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION
1. Alfred University, Alfred, NY [Four-year, small, highly residential, private] undergraduate research, precollege and informal education
2. Barnard College, New York, NY [Four-year, small, highly residential, private] liberal arts college for women, undergraduate research
3. CUNY City College of NY, New York, NY [Four-year, large, primarily nonresidential, public] Minority Serving Institution, NIFS
4. CUNY Medgar Evers College, Brooklyn, NY [Four-year, medium, primarily nonresidential, public] Minority Serving Institution, NIFS, student flight projects (BallonSats and CubeSats), precollege
5. **CUNY York College**, Jamaica, NY *Four-year, medium, primarily nonresidential, public* Minority Serving Institution, NIFS

6. **Clarkson University**, Potsdam, NY *Four-year, medium, highly residential, private* NIFS

7. **Colgate University**, Hamilton, NY *Four-year, small, highly residential, private* undergraduate research and informal education

8. **Columbia University**, New York, NY *Four-year, large, highly residential, private* NIFS, precollege and informal education

9. **Cornell University**, Ithaca, NY *Four-year, large, highly residential, private and public (land grant)* [NYSG lead institution], NIFS, other consortium-wide projects such as summer internship programs, and informal education

10. **Intrepid Sea, Air & Space Museum**, New York, NY – Non-profit informal education affiliate (science museum)

11. **Lockheed Martin**, Owego, NY – Aerospace industry affiliate; student internships

12. **Moog, Inc.**, East Aurora, NY – Aerospace industry affiliate; student internships

13. **New York University (formerly NYU-Poly)**, Brooklyn, NY *Four-year, large, primarily residential, private* Research infrastructure, precollege and informal education

14. **Rensselaer Polytechnic Institute**, Troy, NY *Four-year, medium, highly residential, private* NIFS

15. **Rochester Institute of Technology**, Rochester, NY *Four-year, large, highly residential, private* NIFS

16. **Sciencenter**, Ithaca, NY – Non-profit informal education affiliate (science museum)

17. **SUNY - Binghamton University**, Binghamton, NY *Four-year, large, highly residential, public* NIFS

18. **SUNY Geneseo**, Geneseo, NY *Four-year, medium, highly residential, public* undergraduate research, research infrastructure

19. **SUNY - Stony Brook University**, Stony Brook, NY *Four-year, large, highly residential, public* NYSG is partnered with the LSAMP program, NIFS

20. **SUNY - University at Buffalo**, Buffalo, NY *Four-year, large, primarily residential, public* NIFS, research infrastructure, precollege, and informal education

21. **Syracuse University**, Syracuse, NY *Four-year, large, highly residential, private* NIFS, precollege and informal education projects with partner Museum of Science and Technology (MOST) in Syracuse

22. **Union College**, Schenectady, NY *Four-year, small, highly residential, private* NIFS, precollege and informal education

23. **University of Rochester**, Rochester, NY *Four-year, medium, highly residential, private* undergraduate and graduate research, research infrastructure