

Kentucky Space Grant Consortium

Lead Institution: University of Kentucky

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Lines of Business (LOBs): NASA Internships and Fellowships; STEM Engagement; Institutional Engagement; Educator Professional Development

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 Kentucky Space Grant Consortium is a Designated Consortium funded at a level of \$760,000 for fiscal year 2017.

B. PROGRAM GOALS

NASA Kentucky Space Grant Consortium goals are to develop expertise and capacity for aeronautics, space and science research and education in Kentucky. In fulfilling its mission, the NASA Kentucky program serves several constituencies – NASA, the U.S., and Kentucky, including Kentucky's university/college faculty, students, teachers, and the general public. The NASA Kentucky mix of program elements and emphases offers “Pathways of Opportunities” serving the educational and economic needs of Kentucky and its constituents, aligned with NASA's mission.

The NASA Kentucky Space Grant Consortium objectives are to promote a strong STEM education base by preparing students and teachers; to maintain a network of universities contributing to aeronautics and space; to encourage collaborations among universities, aerospace industry, and government; to support aerospace training, research and public outreach; and to recruit and train U.S. citizens, especially women, minorities and disabled persons.

NASA Kentucky has developed SMART Objectives for each of five program areas: 1) NASA Internships and Fellowships (NIFs); 2) Higher Education; 3) Research Infrastructure; 4) Pre-College; and 5) Informal Education. NASA Kentucky has also established SMART Objectives for student, faculty and institutional diversity.

SMART objectives for the combined FY 2016 Space Grant Base and Augmentation proposal include quantitative targets for Year 3 in each program area as follows: 1) NIFs: 4 NASA Center Internships (NCI), 4 Graduate Fellowships (GF), 3 Undergraduate Fellowships (UF), 3.5 Team Fellowships (TF), and 5 Kentucky Industry Internships (KII); 2) Higher Education: 1 Higher Education Enhanced Mini-Grant (EMG-HE); 3) Research Infrastructure: 2 Research Initiation Awards (RIA); 4) Pre-College & Informal Education: 3 Mini-Grant awards (MG) and 1 Enhanced Mini-Grant award (EMG). Student diversity objectives for Year 3 NIFs programs are at least 40% for female students and 14.6% ($\pm 2\%$) for underrepresented minority students. Year 3 diversity objectives for project mentorship are at least 40% for female PIs and 14.6% ($\pm 2\%$) for underrepresented minority PIs. Institutional diversity objectives are 80% Consortium participation for Affiliate institutions.

C. PROGRAM/PROJECT BENEFITS TO PROGRAM AREAS

NASA Kentucky research fellowships advance student training in technology development projects and scientific investigations important to NASA missions and Kentucky research areas by partnering with the Agency, academic and scientific institutions, and commercial aerospace companies. Each proposal for a NASA KY Graduate Fellowship (GF) must demonstrate collaboration with a NASA or aerospace industry partner. In Year 3 of the current NASA KY Space Grant cycle, 9 Graduate Fellowship proposals were received from 3 Kentucky affiliate institutions with letters of support from 4 NASA Centers, CASIS, the Space Telescope Science Institute, and 4 aerospace companies, including GE Aviation and Space Tango, a Kentucky-based company specializing in providing research services onboard the International Space Station. Eight proposals were selected for award in research areas of dark matter astrophysics, astronaut health studies, small satellite and electric aircraft power systems, spacecraft thermal protection, and flight simulation modeling for the most powerful deep space rocket in development, the NASA Space Launch System (SLS). NASA and industry collaboration is key to success of these awards, providing strategic guidance to Kentucky faculty mentors and graduate students. NASA personnel pledge support to these projects by offering to host faculty and students for technical visits to NASA Centers, providing feedback and review of research direction and progress, and serving as co-authors on scientific papers for research results. The results of NASA KY Graduate Fellowship projects can be incorporated into NASA missions, helping to advance current work towards NASA technical solutions or scientific understanding. NASA KY Undergraduate Fellowships (UF) allow students working towards a bachelor's degree to also participate in advanced research programs and contribute to NASA research goals. Recent UF projects have investigated findings in areas of astronaut health, energy storage, remote sensing, and aerospace materials research.

The NASA Kentucky Team Fellowship (TF) program provides support for student groups participating in higher education design competitions and saw exceptional success during Year 3 of the current NASA KY Space Grant award. Five proposals were received from 4 Kentucky

affiliate institutions, including a community college, and 4 were awarded to begin work on NASA-related team design projects. The Speedfest team from the University of Kentucky (UK) placed third in the 2018 national competition to design and build a remotely piloted jet aircraft and operate it under competition rules to achieve high-speed flight performance objectives. The UK team built their plane from carbon composite materials after developing a low-radar profile “stealth” concept design. Owensboro Community and Technical College (OCTC) participated in the NASA Human Exploration Rover Challenge, designing and building a human-powered rover as an extracurricular activity associated with their advanced manufacturing degree program. After placing in the Top 25 in 2017, OCTC greatly improved upon their success by scoring 9th place in Rover Challenge this year against competition in Huntsville, AL that included 4-year institutions and engineering schools, racing their rover over a simulated lunar surface course to achieve real-world performance goals. The NASA KY TF program encourages awardees to seek follow-on funding in pursuit of sustainability that will continue team projects into future years. Two “alumni” Team Fellowship projects that built competitive programs with previous NASA KY support and then found sources of follow-on funding include teams at the University of Louisville (UofL) and University of Kentucky. The UofL River City Rocketry team placed first in the nation last year and third this year in the annual NASA Student Launch competition which requires a full year of extracurricular activity to meet highly challenging engineering and project management goals. The continuing success of this UofL Speed Engineering School student program is evidenced by Top 5 finishes in seven straight years of competition. University of Kentucky students, utilizing previous Team Fellowship support, coordinated multiple cohorts of senior design teams to develop and build the body and subsystems for a unique spacecraft that achieved its second flight in space this year. KRUPS – Kentucky Re-Entry Universal Payload System – was launched March 25, 2018 from the NASA Wallops launch range and deployed into space for suborbital return through the atmosphere. After previously receiving NASA KY Team Fellowship support, the team and research mentor successfully competed for Space Grant USIP funding to enable this recent launch, with plans to seek additional funding for launch opportunities in the near future.

NASA Kentucky Space Grant assisted state educational institutions with much needed support for activities targeting the “Great American Total Solar Eclipse” of 2017 that brought over 150,000 tourists and millions of dollars in economic impact to western Kentucky as visitors from 47 states and 25 countries came to observe the event from near its maximum eclipse point outside Hopkinsville, KY (the point where the moon provided largest coverage of the sun) on August 21, 2017. NASA KY provided funding to proposals under Higher Education and Enhanced Mini-Grant programs in Year 3 for multiple educational activities across the state. The NASA KY Higher Education Eclipse project supported work of three scientific ballooning teams at the University of Kentucky, Bluegrass Community and Technical College, and Hopkinsville Community College. These teams developed and launched high-altitude ballooning payloads along the path of the eclipse to participate in scientific study of the eclipse and the national Eclipse Ballooning Project, conducted in partnership with national Space Grant consortia and NASA. NASA KY Enhanced Mini-Grants were also utilized by Kentucky affiliate institutions, including Western Kentucky University, the Living Arts & Science Center, and Kentucky Science Center / Challenger Learning Center of Louisville, to conduct educational programming for pre-college and informal education audiences in support of Eclipse activities occurring in Paducah, Hopkinsville, Cadiz, Benton, Russellville, Bowling Green, Lexington and Louisville.

D. PROGRAM ACCOMPLISHMENTS

- NASA Internships and Fellowships (NIFs):

NASA Kentucky objectives for NIFs awards in Year 3 of the combined Space Grant Base and Augmentation award include: 4 NASA Center Internships, 4 Graduate Fellowships, 3 Undergraduate Fellowships, 3.5 Team Fellowships, and 5 Kentucky Industry Internships, with 40% diversity for female students and 14.6% ($\pm 2\%$) for underrepresented minority students among NIFs programs. The Year 3 RFP received 21 NIFs proposals from Kentucky Space Grant Consortium affiliate institutions. NASA KY awarded support for 8 GF, 2 UF, and 4 TF projects. In addition to programs funded through the annual NASA KY Space Grant RFP, NASA Kentucky awarded 3 Kentucky Industry Internships and partnered with NASA to support 6 NASA Center Internships, selected from among 88 Kentucky students who were eligible for Summer 2018 internships through the NASA OSSI system. Most Year 3 NIFs award targets were met and exceeded. NIFs proposals and internships indicated participation from 8 different affiliate institutions among all project categories, including one community college (OCTC). Self-reported demographic information from students in Year 3 NIFs programs indicate 42% female student participation and 10.5% underrepresented minority student participation.

- Higher Education projects:

NASA Kentucky objectives for Higher Education projects in Year 3 of the combined Space Grant Base and Augmentation award are for 1 Higher Education Enhanced Mini-Grant (EMG-HE) award. The Year 3 RFP received no EMG-HE proposals from Kentucky Space Grant Consortium institutions. Target objectives were met a year early (in Year 2) for awards under the Higher Education category cumulative through Year 3. Year 3 saw continuation of performance for Higher Education projects that began in previous years, including the LSST project and the Total Solar Eclipse project, which addressed needs of the Consortium to support NASA & state education initiatives for the August 2017 eclipse.

- Research Infrastructure projects:

NASA Kentucky objectives for Research Infrastructure projects in Year 3 of the combined Space Grant Base and Augmentation award are for 2 Research Initiation Awards (RIA). The Year 3 RFP received 3 RIA proposals from Kentucky Space Grant Consortium institutions and awarded all based on merit review. This exceeded the awards target for Year 3 and continued to make progress against a low number of RIA proposals from Year 1. Funding not awarded to RIAs in Year 1 was re-allocated towards 2 additional Higher Education Enhanced Mini-Grant (EMG-HE) awards in Year 2 due to a higher number of proposals received in that category.

- Pre-college and Informal Education projects:

NASA Kentucky objectives for Pre-college and Informal Education projects in Year 3 are grouped together in the combined Space Grant Base and Augmentation award. Year 3 targets for these program areas include 3 Mini-Grant awards (MG) and 1 Enhanced Mini-

Grant award (EMG). The Year 3 RFP received 7 MG proposals and 3 EMG proposals. Three MG proposals were awarded, which met the annual target for these awards, however one institution cancelled an MG award prior to performance due to a state budget shortage affecting public higher education institutions. This reduced the active number of MG awards to 2, one below the annual target. All EMG proposals were awarded, which exceeded the annual target for these awards, however an affiliate institution also cancelled an EMG award due to state budget cuts, reducing the active number of EMG awards from 3 to 2 but still exceeding the annual target. Proposals in Pre-college and Informal Education categories indicated participation of an additional 5 affiliate institutions not already participating in other categories, marking a total of 13 different institutions applying for award funding under the Year 3 program year. Diversity results of self-reported demographic information from PIs in Year 3 for these awards indicate 67% female participation (4 of 6 awards). Several projects include outreach to underserved rural and urban school districts in regions across the state.

E. PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE GOALS

- **Diversity:**

Institutional diversity is measured as the number of affiliate institutions participating in Consortium programs. Affiliate participation in Consortium activities has a target of 80% participation. Target met – 100% of Kentucky Space Grant Consortium affiliates participated in proposal reviews, meetings or other Consortium business; PIs from 12 different affiliates across the state submitted proposals for the Year 3 RFP; PIs and students from 13 different affiliates received Year 3 awards.

Project leadership diversity is measured as the number of female and underrepresented minorities participating as PIs across all awards. Objectives in Year 3 include supporting at least 40% female PIs and 14.6% ($\pm 2\%$) underrepresented minorities. Participation of female PIs was 32% across all proposals awarded under the RFP. Underrepresented minorities were not among PIs who were selected for RFP awards.

Student diversity is measured as the number of female and NCES underrepresented minorities receiving direct awards in NIFs programs, including Graduate Fellowships (GF), Undergraduate Fellowships (UF), NASA Center Internships, and Kentucky Industry Internships. Objectives include funding at least 40% female student participation in Year 3 and 14.6% ($\pm 2\%$) underrepresented minority students. Targets were met for female participation and slightly under target for minority participation – self-reported demographic information from students in Year 3 NIFs programs indicate 42% female student participation and 10.5% underrepresented minority student participation.

- **Minority Serving Institution Collaborations:**

Collaboration with two Kentucky MSIs continued, with participation of Consortium affiliates Kentucky State University (KSU) and Hopkinsville Community College (HCC), a minority-

serving community college, in meetings, proposals, and other Consortium business. A KSU student was selected by NASA Kennedy Space Center for a Summer 2017 internship and funded under the Consortium's NASA Center Internship program. Hopkinsville Community College faculty and students developed an active high-altitude balloon launch program following Space Grant MSI program balloon training at MSFC in early 2015 and participated in the national Eclipse Ballooning Project and post-eclipse activities in Year 3.

- **Office of Education Annual Performance Indicators:**

- API 2.4.1: ED-17-1 ____19 direct student awards: across all institutional categories, to underrepresented students, and to women. ____
- API 2.4.2: ED-17-2 ____94 educators____
- API 2.4.4: ED-17-4 ____5 STEM Education partnerships include Consortium affiliation as well as Enhanced Mini-Grant and Mini-Grant awards to Ashland Community and Technical College, the Aviation Museum of Kentucky, Kentucky Science Center/Challenger Learning Center of Louisville, Living Arts & Science Center, and West Kentucky Community and Technical College/Challenger Learning Center of Paducah____
- API 2.4.5: ED-17-5 ____140,676 elementary and secondary students____

F. IMPROVEMENTS MADE IN THE PAST YEAR

Improvements made in the last year include adding three new affiliates to the Consortium. West Kentucky Community and Technical College in Paducah, KY serves as host of the Challenger Learning Center of Paducah, making both entities now eligible for NASA KY Space Grant funding. Two start-up companies founded by alumni of NASA KY programs also joined the Consortium, Space Tango and Faradine Systems. Both companies provide commercial services to enable research studies onboard the International Space Station.

G. CURRENT AND PROJECTED CHALLENGES

Current and projected challenges continue to include effects from shortfalls in the Kentucky state budget. As a result, state agencies are undergoing budget reductions and restructuring in areas that have traditionally supported Space Grant, resulting in challenges to meet NASA Space Grant cost-share requirements as state cash match becomes less available and in-kind match becomes more restricted.

H. PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

Academic Affiliates:

Ashland Community and Tech. College	Community/Technical College
Bellarmine University	Private, Parochial University
Berea College	Private, Work College
Bluegrass Community and Tech. College	Community/Technical College
Centre College	Private College
Eastern Kentucky University	Public Comprehensive University
Hopkinsville Community College	Community/Technical College, MSI
Kentucky State University	Public Comprehensive University, MSI
Morehead State University	Public Comprehensive University
Murray State University	Public Comprehensive University
Northern Kentucky University	Public Comprehensive University
Owensboro Community and Tech. College	Community/Technical College
Thomas More College	Private, Parochial College
University of Kentucky	Public Doctoral Granting University
University of Louisville	Public Doctoral Granting University
University of Pikeville	Private, Parochial University
West Kentucky Community and Tech. Coll.	Community/Technical College
Western Kentucky University	Public Comprehensive University

Non-Academic Affiliates:

Aviation Museum of Kentucky	Museum (STEM)
Faradine Systems	Industry
Innoviator, LLC	Industry
Kentucky Science and Technology Corp.	Non-profit Organization
Kentucky Science Center	Museum (STEM)
The Living Arts and Science Center	Museum (STEM)
Space Tango, Inc	Industry
Tribo Flow Separations, LLC	Industry