Kentucky Space Grant Consortium
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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 $**575,000** for fiscal year 2013.

PROGRAM GOALS

The NASA Kentucky Space Grant (NKSG) goals are to serve the needs and emphases of NASA's National Space Grant College and Fellowship Program while serving the specific needs of the Commonwealth of Kentucky, through a program that enhances capabilities for aeronautics- and space-related research and education in Kentucky, and develops future workforce for NASA, Kentucky, and the nation. Therefore, NASA Kentucky Space Grant strives 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. Kentucky Strategic Themes and Kentucky Emphases compliment NASA Educational Outcome Objectives and NASA Emphases while guiding definition of the 2010-2014 NKSG programs.

NKSG Strategic Theme #1: Pathways of Opportunities – Programs build on Kentucky's space science specialization, starting immediately and spanning the full five years of the plan to: 1) Provide integrated progressions of opportunities for STEM workforce development to meet NASA priorities, 2) Mirror NASA's Education Framework to Inspire, Engage, Educate, Employ, 3) Incorporate recognized local scientific sites (planetaria and observatories) as statewide outposts for teacher training, student internships, diversity engagement, and KSGC Affiliate leadership and involvement, 4) Be a catalyst for higher

education recruitment, and 5) Enhance in-state employment in Kentucky's aerospace industry.

NKSG Strategic Theme #2: NextGen Partnerships - Programs were developed early in the 5-year cycle then phased-in to provide: 1) A new in-state aerospace engineering degree option, 2) An emphasis on aeronautics R&D, 3) New links to the Kentucky Community and Technical College System (KCTCS), and 4) A new high-school-to-higher-education pathway combining aviation and aerospace supporting NASA's NextGen Air Transport initiative.

To achieve these goals, SMART objectives were defined in the FY 2010 proposal and revised in February 2013 with the Mid-Course Assessment. SMART objectives were revised to focus on measurable targets for students, awards, diversity, and institutional involvement and to move long-term indicators to become gauges of systemic change. Revised objectives and other actions resulting from the Mid-Course Assessment are indicated below (*).

PROGRAM/PROJECT BENEFIT TO OUTCOME (1,2, & 3)
PROGRAM ACCOMPLISHMENTS

Outcome 1: The discovery of over 700 planets orbiting stars other than the Sun over the past 20 years has confirmed that the Sun is not unique among stars in hosting planets. One of these exoplanets, KELT-6b, was discovered by NASA Kentucky Space Grant-supported research and announced at the June 2013 meeting of the American Astronomical Society. KELT-6b is a gas-giant resembling Saturn in size and mass with a 7.8 day orbit around its bright metal-poor star. Data for this project are collected using half-meter class, research-grade telescopes at Moore Observatory near Louisville, Kentucky. KELT-6b is in the constellation Coma Berenices, and its five hour transit is the longest duration full planetary transit continuously observed from the ground. Karen Collins (University of Louisville), a supported NASA Kentucky Space Grant Graduate Fellow, led the team that made the discovery. She presented the exoplanet discovery techniques, data collection and verification process, and planet's unique characteristics and important role in comparative planetology at the 25th Space Grant Celebration in Charleston, SC in October 2013.

Outcome 2: An incoming Freshmen Women and Minority Retention Event was sponsored for the UK College of Engineering at the Aviation Museum of Kentucky (AMK, a new Space Grant affiliate) as a pilot event to evaluate the logistics and benefits of a pre-term gathering of incoming minority cohort students. Students applied by submitting a brief essay. For the pilot, there were 16 total incoming freshmen students attending, 12 female and 4 under-represented minority students, representing 9 engineering disciplines. Observations included the following: 1) Students were seeking contacts among their incoming freshman peers and immediately talked and exchanged contact info with each other; 2) Museum (AMK) instructors were enthusiastic and engaging as this event was also a trial for them of new material; and 3) The attending students answered questions and seemed well-prepared for college and engineering coursework. Success of the 2013 event led to a recommendation to schedule a second offering in 2014 (scheduled for June 21,

2014). The Society of Women Engineers (SWE) and the National Society of Black Engineers (NSBE) are co-sponsoring for 2014, along with the NSF Louis Stokes Alliances for Minority Participation (LSAMP). Finally, the focus was engagement for retention of minority freshman students (female and minority), but this might be adapted for other minority STEM cohorts such as first-generation, rural Appalachian or transitioning community college students. We also recommended an annual repeat of the Engineering-in-Context pre-term event in the future – with different contexts (for example, it could be hosted at Toyota with a context of Automotive).

Outcome 3: Extending research originally supported in 2012 by a Space Grant Research Initiation Award for early-career faculty, Dr. Jennifer Wilhelm (UK), and her doctoral student Merryn Cole, received a 2013 Space Grant Mini-Grant Award. In partnership with a unique after-school program and local government funding, they conducted research on how well at-risk sixth grade students interacted with the REAL (Realistic Explorations in Astronomical Learning) project-based curriculum, using materials developed under NASA support, as the students engaged in integrated mathematics and science learning in a formal classroom setting and in an informal after-school setting. A quantitative approach was used with this semester-long study to expose how focused experiences with REAL affected male and female students' STEM self-efficacy and facilitated students' spatial-scientific understandings within both formal and informal arenas. Significant gains were made on a Spatial Orientation Test for students in both the formal and informal settings and on mathematical self-efficacy domain items for females in the formal setting. The program was profiled in a story in the Lexington Herald Leader newspaper on March 12, 2013. Research results are being disseminated to the STEM education research community via submission of technical conference and archival publications. Merryn Cole presented the research and efficacy results at the Spring 2014 National Space Grant Directors Meeting in Washington DC.

PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE MEASURES

Program accomplishments refer to goals defined in the 2010 KY proposal and to SMART objectives revised in the 2012 KY mid-course review. Revised objectives and other actions resulting from the Mid-Course Assessment are indicated with asterisks (*). Diversity accomplishments are presented as program contributions to NASA Education Performance Measures under MSI Collaborations and NASA Priorities – Diversity, as well as under Improvements Made in the Past Year.

Outcome 1: Fellowship/Scholarship, Higher Education and Research Infrastructure

Graduate Fellowships (GF): *Revised objectives include funding 4 GF F/S per year, with 1 publication/presentation per fellow. Targets met – 4 graduate fellows; 7 publications/presentations.

Undergraduate Scholarships (US): *Revised objectives include funding 3 US F/S per year. Target met – 6 undergraduate scholars.

NASA Academy/Interns, Outpost and NextGen Interns (Interns): *Revised objectives include funding 5 F/S Interns per year. Target to be met –7 interns (three female) placed at ARC (2), LaRC (2), KSC (1), MSFC (1), and NextGen (1); NASA selection process and LSAMP Partnership still underway.

Team Projects (TP): *Revised objectives include funding 1 F/S TP per year. Target met – 2 team projects including UAV Challenge (1) and Robotics Competition (1).

Travel Scholars: *Revised objectives include funding 4 F/S travel scholars per year. Target to be met – Karen Collins (UL) presented at the 25th SG Anniversary Celebration; Merryn Cole (UK) presented at the Spring 2014 SG Directors Meeting in DC. Prior NASA Academy interns who were recently selected for NASA-supported internships (Lydia Brothers, Mary Walker, etc.) are eligible; travel awards are still in process.

Research Infrastructure Development Research Initiation Awards (RIA): *Revised objectives include funding 2 total longitudinally tracked (LT) students under 5 RIA per year, with 2 publication/presentations per PI. Targets met – 5 RIA awards; 12 publications/ presentations; 3 LT students.

Higher Education, Kentucky Space and NextGen Partners: *Revised objectives at Mid-Course included funding 6 total longitudinally tracked (LT) students, involving 4 HE institutions and developing one new industry contact per year. (*Note that the target for total LT students under all Higher Ed projects was 8 for years including Kentucky Space, Year-1 to Year-3. With the end of the Kentucky Space project in Year-3, the target number of total LT students for Higher Ed programs is reduced to 2, the total above for the RIA LT students.) Targets met – 3 LT student in addition to 3 above (6 total under Higher Ed in Year-4); 4 HE institutions; new partnership established with Theta Tech Solutions in Louisville KY including co-advising a aeronautics team project.

Curriculum Development/Revision (CDR): *Revised objectives include supporting development/revision 1 course per year. Target met – 1 CDR award for 2013-2014.

Outcome 2: Precollege Education

Precollege education events: *Revised objectives include 2,000 PSP per year. Target met – Engineers Day Open House (800), WDC (est. 350), SpaceTrek Girls STEM Camp (21), Living Arts & Science Discovery Night (81), STEAM Academy (13), GEMS (78), and UAV and SSL lab tours (1400).

Mini-grants (MG): *Revised objectives include supporting 6 MG awards per year. Target met – 6 total mini-grant awards: 3 MG awards, 2 Girls STEM Collaborative Partnership awards and 1 SSEP Partnership award to The Academy at Shawnee High School.

New outpost contacts: *Revised objectives include new contact with one site per year. Target met – Two museums added as affiliates (Aviation Museum of Kentucky and

Kentucky Science Center) with activities at each in 2013-2014, plus activity at Living Arts and Science Center, Lexington, KY who will now apply to become a Space Grant Affiliate.

New NextGen partner contacts: *Revised objectives include new contact with one new partner per year. Target met – more than 12 new unmanned systems industry contacts resulted from co-sponsoring the Dec 11, 2013 Kentucky Unmanned Systems Summit; additional contacts included new affiliates, Innoviator and Theta Tech Solutions.

Outcome 3: Informal Education

Informal Education Events/Partnerships: *Revised objectives include supporting/participating in 3 informal education events per year: Target met – Engineers Day Open House Feb 2014, Campus Recruitment tour stop, Wing Design Competition open to the public again in 2014, National Conference on Undergraduate Research (NCUR) Open House tours April 2014, Living Arts and Sciences Center Discovery Night (flight and kite-making) Mar 2014, Astronaut Scholarship Foundation Award Presentation by Joe Kerwin October 2013, among others.

- **Student Data and Longitudinal Tracking:** Total awards = 27; Fellowship/Scholarship = 21, Higher Education/Research Infrastructure = 6; 3 of the 21 F/S awards represent underrepresented minority funding (4 of the 27 total awards represent underrepresented minority funding). During the FY13 program year 5 students are pursuing advanced degrees in STEM disciplines, 1 accepted a STEM position at a NASA contractor, 10 accepted STEM positions in industry, 1 accepted a STEM position in academia, and 7 went on to positions in non-STEM disciplines. The remaining students have not yet received the degree that they were pursuing while they received their Space Grant award.

- **Minority-Serving Institution Collaborations:** A NASA Kentucky Space Grant and EPSCoR event including NASA Kentucky staff and EPSCoR researchers successfully attracted students and faculty to learn more about our programs and opportunities. Despite a snowy start, the NASA Kentucky Day on March 6, 2013 featured tabletop research presentations and demonstrations and flyers for NASA student opportunities (SOLAR, AcademyApp, LARSS). We understood that as a result, two students may have completed OSSI or LARSS applications in 2013. However, NASA Kentucky does not have access to OSSI, so we do not have information on numbers of KSU applicants to NASA's summer internship programs (one Computer Science student, Luis Urbina, was a NASA Summer Intern in 2011); we have not been notified of any who have been selected for internship offers since then.

  However, KSU faculty are included in the multi-university group receiving the NASA Space Grant STEM Pilot (2013 award with John Farrar, NKU, PI). The kick-off meeting for the STEM Pilot program was held at the NASA Kentucky offices in Fall 2013. KSU faculty and students will be involved in that effort.

We also have a significant increase in KSU faculty involvement with the NASA Kentucky EPSCoR program, which will also attract students to Space Grant. The NASA Kentucky Space Grant and EPSCoR Programs are an integrated portfolio offering a pathway of opportunities for students building their experience resumes and for faculty building their research programs and NASA connections. Since the March 2013 KSU event, 2 KSU faculty members applied for, received and completed 3 trips under the EPSCoR RID faculty travel augmentation for travel to NASA centers. Also, two other KSU Computer Science faculty members are participating with students on EPSCoR Research awards, Dr. Jens Hannemann as an undergrad research mentor (2012 award with Soucy, UL, Science PI) and Dr. Chi Shen to implement graphic processing unit (GPU) acceleration of simulations for ablative thermal protection systems (2013 award with Martin, UK, Science PI). Further, one KSU faculty member, after traveling to visit NASA colleagues, submitted an EPSCoR Research Infrastructure Development Grant (RIDG) proposal for 2014 and received improvement feedback when it was not selected. Overall, since the NASA Kentucky-KSU Event in March 2013, 5 KSU faculty have been newly attracted to and participated in NASA EPSCoR programs.

Unfortunately, similar increases in interactions are not seen in the Space Grant programs. Once again in Year-4, no proposals were submitted by KSU faculty to the Space Grant opportunities. We attribute this to two root causes: 1) an inactive affiliate representative and 2) non-US faculty members at KSU. To address the former, during affiliate expansion and reaffirmation that occurred through early Fall 2013, we contacted the Provost of KSU and requested appointment of a new affiliate representative. This request was not granted. Nearly 1/3 (4) of the original 13 affiliates have appointed new representatives, but KSU did not. We plan to continue the overall interaction momentum through the non-US KSU faculty who started their engagement via our EPSCoR programs, their students and all connections already established between NASA Kentucky and KSU.

Finally, Kentucky State University is a partner of the recently-awarded NSF Kentucky-West Virginia Louis Stokes Alliances for Minority Participation (LSAMP) program. NASA Kentucky is a partner of the KY-WV LSAMP program, co-sponsoring up to 6 summer research interns annually. Dr. Suzanne Smith and Mark Pittman attended the Alliance meeting on Friday April 4, 2014.

- **NASA Education Priorities:**
  In 2013-2014, Kentucky SGC funded or hosted 27 projects/initiatives under the F/S, Higher Ed and Pre-College programs (excluding NASA Center summer interns). These projects and initiatives addressed both strategic themes: Space Science pathways and NextGen partnerships. These 27 projects/initiatives aligned with the 8 NASA Education priorities as follows:

  - Authentic, hands-on student experiences in science and engineering disciplines – the incorporation of active participation by students in hands-on learning or practice with

experiences rooted in NASA-related, STEM-focused questions and issues; the incorporation of real-life problem-solving and needs as the context for activities.

26 of the 27 projects provide authentic hands-on experiences to higher-education students and to pre-college students and teachers through team projects (2), graduate fellowships (4), undergraduate scholarships (6), research initiation awards (5), mini-grants (5) and higher education initiatives (3). Projects range from community college faculty developing a simulation for CubeSat radiation exposure to prediction of invasive species distributions with NASA data and bioclimatic variables.

- Diversity of institutions, faculty, and student participants (gender, underrepresented, underserved).

  18 of 27 projects expand diversity participation in Kentucky, including 6 involving female faculty or students, 11 of 27 projects or initiatives involving regional/comprehensive and community college institutions, and 1 initiative (LSAMP Partnership) involving an MSI institution. The LSAMP Partnership is detailed above under Minority-Serving Institution Collaborations, targeting support of 3-6 interns per year. Three 2014 interns are included in the following summary.

  *Revised Mid-Course objectives include funding 3 LT minority students, 14.6% NCES minority participation, 35% student female participation (Year-4) and conducting one MSI recruiting event. Targets met or exceeded - 10 of 27 total longitudinally-tracked (LT) students are female for 37% female participation; 4 of 27 LT students are underrepresented minority for 14.8% minority participation (NASA selection process and LSAMP selection process still underway).

  Institutional diversity is measured as the number of higher education institution (HEI) affiliates participating in the consortium programs. The objective is 8 HEI. Target met – >14 different HEI affiliates participated in reviews/attended consortium meetings; 6 different HEI affiliates had PIs submitting proposals; 6 different HEI affiliates had PIs receiving awards.

- Engage middle school teachers in hands-on curriculum enhancement capabilities through exposure to NASA scientific and technical expertise. Capabilities for teachers to provide authentic, hands-on middle school student experiences in science and engineering disciplines (see above).

  One of the 27 2014 Space Grant projects directly involves pre-service teachers. In addition, Kentucky was awarded one of the nine STEM Pilot awards (NASA Kentucky oversaw statewide down-select process to determine two Kentucky applicants).

- Summer opportunities for secondary students on college campuses with the objective of increased enrollment in STEM disciplines or interest in STEM careers.

7 of 27 projects provide summer opportunities for secondary students on college campuses: a space engineering workshop for high school girls at Morehead State University and the Kentucky Institute for Aerospace Education (KIAE) family flight day at Eastern Kentucky University, among others.

- Community Colleges – develop new relationships as well as sustain and strengthen existing institutional relationships with community colleges.

  Two Community Colleges became affiliates of the Space Grant program: Owensboro Community & Technical College (OCTC) and Bluegrass Community & Technical College (BCTC). One faculty member from BCTC proposed and was selected for a project award.

- Aeronautics research – research in traditional aeronautics disciplines; research in areas that are appropriate to NASA's unique capabilities; directly address the fundamental research needs of the Next Generation Air Transportation System (NextGen).

  6 of 27 projects involve research in aeronautics, connecting faculty at university sites across Kentucky to NASA researchers.

- Environmental Science and Global Climate Change – research and activities to better understand Earth's environments.

  2 of the 27 projects involve environmental science and global climate change.

- Enhance the capacity of institutions to support innovative research infrastructure activities to enable early career faculty to focus their research toward NASA priorities.

  15 of 27 projects involve early-career faculty in research initiation awards building NASA partnerships and preliminary research results, mentoring graduate students, mentoring undergraduate research and developing curriculum materials.

IMPROVEMENTS MADE IN THE PAST YEAR

NASA KY continues to update its communications, proposal review process and Affiliate resources due in large part to the addition of Jacob Owen to the staff. The website is updated regularly and our Twitter account has nearly 400 followers. Affiliate Representatives also receive customized email updates summarizing opportunities rather than numerous forwarded email announcements. Receipt and review of proposals is significantly easier and more secure now that reviewers receive secure PDF copies of proposals and review forms via email. Reviewer comments are readily compiled for the committee to use during in person or telecon selection meetings and then provided to each PI with their selection notification. In the past, PIs have complained about delays in receiving reviewer comments.

On May 20, 2013, NASA Kentucky held a Strategic Planning meeting with all of the Affiliate Representatives. The agenda included review of the Mid-Course Assessment,

federal budget climate, drafting by-laws and initial planning for the next five year program cycle. No new Affiliate organizations had been added to the Kentucky Space Grant Consortium since the early years of the program. In Year 4, all of our Affiliates were asked to reconfirm their affiliation with NASA Kentucky and identify their Affiliate Representative. For the first time, NASA Kentucky hosted an orientation meeting (January 10, 2014) for Affiliate Representatives to introduce several new Representatives to the programs and to their counterparts. The one day retreat provided the Representatives with a notebook full of reference documents and was also an opportunity to reinforce the goals of NASA Space Grant, distinguish between Space Grant and EPSCoR programs and encourage partnerships between Affiliates. Several more community and technical colleges have requested affiliation as well as another museum and a regional university.

As a result of budget constraints and workload distribution, NASA Kentucky has eliminated the reception/staff assistant position and promoted the program coordinator position to Assistant Director. The UK College of Engineering has absorbed some clerical responsibilities (travel, invoices, ordering, etc) within the Mechanical Engineering Department and NASA Kentucky may still hire hourly or temporary staff as needed for data entry or special events.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

Academic Affiliates

Bellarmine University	Private, Parochial University
Berea College	Private, Work College
Bluegrass Community and Technical Col	Community/Technical College
Centre College	Private College
Eastern Kentucky University	Public Comprehensive University
Kentucky State University	Public Comprehensive University, HBCU
Morehead State University	Public Comprehensive University
Murray State University	Public Comprehensive University
Northern Kentucky University	Public Comprehensive University
Owensboro Community and Technical Col	Community/Technical College
Thomas More College	Private, Parochial College
University of Kentucky	Public Doctoral Granting University
University of Louisville	Public Doctoral Granting University
Western Kentucky University	Public Comprehensive University

Non-Academic Affiliates

Aviation Museum of Kentucky	Museum (STEM)
Innoviator, LLC	Industry
Kentucky Institute for Aerospace Education	Non-Profit Organization
Kentucky Science and Technology Corp.	Non-profit Organization
Kentucky Science Center	Museum (STEM)
Kentucky Space, LLC	Industry
Theta Tech Solutions, LLC	Industry
Tribo Flow Solutions, LLC	Industry