

**The National Space Grant Office requires two annual reports, the Annual Performance Data Report (APD – this document) and the Office of Education Performance Measurement System (OEPM) report. The former is primarily narrative and the latter data intensive. Because the reporting timeline cycles are different, data in the two reports may not necessarily agree at the time of report submission. OEPM data are used for official reporting.**

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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 2014.

## 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 complement 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, and 3)

**Outcome 1:** Innovative remote sensing techniques developed by Dr. Haluk Cetin at Murray State University generate maps of land cover change, environmental impact, vegetation and wetlands in western Kentucky. The test sites are validation and verification sites for the Landsat Data Continuity Mission now called Landsat 8. As part of his Research Initiation Award (RIA), Dr. Cetin collaborated with Dr. James C. Tipton at GSFC, utilized object-oriented and non-parametric classifications, incorporated the experimental and analytical methods into graduate and undergraduate courses and organized an outreach event on Earth Day 2014. The event included poster presentations and oral presentations by the undergraduate and graduate students involved in the research and courses, as well as a keynote speaker from industry. This well-rounded project included authentic hands-on practices, STEM workforce development, environmental science and enhancing research capacity toward NASA priorities.

**Outcome 2:** For several years, NASA Kentucky has awarded a Mini-Grant to WKU to help support the Cave Area Rocket Scientists (CARS) competing in the national Team America Rocketry Challenge (TARC). Teams of middle and high school students in Hart County are organized through the 4-H office to bring together diverse students from public schools and home-schooling. Hart County is a rural community with limited resources making it difficult for parents and schools to provide travel support for students to participate in the national TARC competition. CARS teams have repeatedly advanced

to nationals and one team was selected to participate in the Student Launch Initiative (now NASA Student Launch) program at MSFC. With multiple teams participating in tiered competitions, CARS has the capacity to attract larger numbers of rural students to STEM activities, provide opportunities for growth and leadership, introduce students to NASA and retain them in STEM career paths. Alumni of the program are currently studying Mechanical Engineering at UK, Production Engineering at WKU, Aerospace Engineering at Purdue and Aerospace and Mechanical Engineering at UA-H with an internship at the Boeing Design Center in Huntsville.

**Outcome 3:** STEM literacy translates to METS to emphasize the central role mathematics play in engineering, technology and science at the High School Mathematics Day for Women at UK. Faculty, undergraduates and graduate students from the Math Department organized small group activities on ciphers, polydrons and origami, breakout sessions on the game SET and modeling of infectious diseases, and concluded with a career talk by a STEM education researcher with support from a NASA Kentucky Mini-Grant. In addition to the successful one-day event, bimonthly math circles are hosted for high school and elementary school students. The high school circle meets on the UK campus to help the students see the link between the informal education experience and higher education opportunities. The public elementary school selected has approximately 40% underrepresented minority and 70% low SES enrollment. While mentoring younger students, the graduate students involved in the program gained a deeper appreciation for outreach and developed a stronger culture of giving back to the surrounding community.

## PROGRAM ACCOMPLISHMENTS

**Outcome 1:** *Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals:* (Discussion of achievements and progress related to Fellowship, Scholarship, Internship, Higher Education and Research Infrastructure programs). (*Employ and Educate*)

Graduate Fellowships (GF): \*Revised objectives include funding 4 GF F/S per year, with 1 publication/presentation per fellow. Targets met – 8 graduate fellows; 9 publications/presentations.

Undergraduate Scholarships (US): \*Revised objectives include funding 3 US F/S per year. Target met – 5 undergraduate scholars.

NASA Academy/Interns, Outpost and NextGen Industry Interns (Interns): \*Revised objectives include funding 5 F/S Interns per year. Target to be met – 1 intern with LaRC funded for Spring 2015; 4 interns will be placed at NASA Centers for Summer 2015, selection process still underway.

Team Projects (TP): \*Revised objectives include funding 1 F/S TP per year. Target met – 5 team projects including NASA Student Launch, NASA BalloonSat Workshop, NASA ICESat-2 Hexacopter Challenge, robotics competition, and re-entry vehicle design.

Travel Scholars: \*Revised objectives include funding 4 F/S travel scholars per year. Target met – Funded travel for 4 students participating in the NASA Marshall BalloonSat Workshop, January 2015.

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. (\*Note that the combined LT students target under all Higher Ed projects is now 2). Targets met – Funded 4 RIA awards that were reviewed fund/fund if possible and allocated remaining RIA funds for this year to a GF (meets same programmatic requirements for relationship-building with NASA); 15 publications/ presentations; 2 LT students.

Higher Education, Kentucky Space and NextGen partners: \*Revised objectives include 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 now reduced to 2, the total above for the RIA LT students.) Targets met – 3 LT students in addition to 2 above (5 total under Higher Ed); 4 HE institutions; transitioned sponsorship by Stantec and other companies for Wing Design pre-college aerospace program.

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

**Outcome 2:** *Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty:* (Discussion of achievements primarily focused on Higher Education programs not discussed in Outcome 1 and Precollege programs). (*Educate and Engage*)

Pre-college education events: \*Revised objectives include 2,000 PSP per year. Target met – Engineer’s Day Open House 2015 (800), Wing Design Competition (350), Space Trek Girls STEM Camp (20), Girls Enjoying Math and Science (GEMS) Girl Scout Program (350), UK UAV and SSL lab tours (500).

**Outcome 3:** *Build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA’s mission:* (Achievements and progress of Informal Education programs). (*Engage and Inspire*)

Informal Education Events/Partnerships: \*Revised objectives include supporting/participating in 3 informal education events per year: Target met – Engineer’s Day Open House 2015, Campus Recruitment tour stops, Girls Enjoying Math and Science (GEMS) Girl Scout program, among others.

Mini-grants (MG): \*Revised objectives include supporting 6 MG awards per year. Target met – 7 total mini-grant awards for STEM and aerospace camps, teacher workshops, planetarium programs.

New outpost contacts: \*Revised objectives include new contact with one site per year. Target met – The Living Arts and Science Center (LASC), Lexington, KY added as a Space Grant Affiliate.

New NextGen partner contacts: \*Revised objectives include new contact with one new partner per year. Target met – joined as member of the Kentucky Aviation Association.

## PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE MEASURES

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

19 of 32 projects expand diversity participation in Kentucky, including 15 involving female faculty or students, 11 projects or initiatives involving regional/comprehensive and community college institutions, and 1 initiative (BalloonSat) involving an MSI institution.

\*Revised Mid-Course objectives include funding 3 LT minority students, 14.6% (+/- 2%) NCES minority participation, 40% student female participation (Year-5) and conducting one MSI recruiting event. Targets met or exceeded - 9 of 22 total longitudinally-tracked (LT) students are female for 40.9% female participation; 3 of 22 LT students are underrepresented minority for 13.6% minority participation (NASA intern 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 – 13 different HEI affiliates participated in reviews/attended consortium meetings; 8 different HEI affiliates had PIs submitting proposals; 8 different HEI affiliates had PIs receiving awards.

- **Minority-Serving Institution Collaborations:** *Summarize interactions with MSIs within the consortium, and describe projects/activities.*

Hopkinsville Community College joined the NASA Kentucky Space Grant Community College project, then became interested in joining the Consortium, applied and was approved this past year. HCC joins KSU, KY's other MSI, as an affiliate. Identified as a 2-year MSI, HCC offers academic programs to civilian students and military personnel on its main campus in Hopkinsville and its satellite campus at Fort Campbell. NASA Kentucky communicated the NASA Marshall BalloonSat program opportunity to HCC, they applied, were accepted and awarded with registration and travel support from the workshop. Currently HCC is receiving additional technical guidance from NASA KY to

continue establishment of their high-altitude ballooning program, with a first launch from western Kentucky scheduled in April 2015. HCC is also participating with NASA KY in initial planning for the 2017 total solar eclipse with path of totality passing near their main campus.

NASA Kentucky continued its collaboration with Kentucky State University, the state's only 4-year MSI, in several ways including assistance with proposal preparation and a letter of support for MUREP and discussion of Space Grant program opportunities with the Dean of the College of Agriculture, Food Science, and Sustainable Systems (CAFSSS). NASA Kentucky hosted a KSU student to present her research proposal prepared under a NASA KY – LSAMP partnership to a diverse group of UK administrators, faculty, and students, and discussed further collaboration with the KSU student's faculty mentor. NASA KY also recruited several KSU faculty members to consider submitting proposals for the annual NASA KY Space Grant RFP.

- **NASA Education Priorities:**

In 2014-2015, Kentucky SGC funded or hosted 32 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 32 projects/initiatives aligned with 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.

31 of the 32 projects provide authentic hands-on experiences to higher-education students and to pre-college students and teachers through team projects (5), graduate fellowships (8), undergraduate scholarships (5), research initiation awards (4), mini-grants (7) and higher education initiatives (2). Projects range from participation in NASA team challenges and workshops to contributing to advanced laboratory research.

- 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).

4 of the 32 projects directly involve pre-service and in-service teachers, including a mobile and web-based geospatial technology workshop, a mobile astronomy program, and a STEM aerospace curriculum.

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

3 of 32 projects provide summer opportunities for secondary students on college campuses, including a space science workshop for high school girls at Morehead State University and a robotics camp for students ages 10-18 at Ashland Community and Technical College in eastern Kentucky.

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

3 of 32 projects involve affiliates from community colleges. 2 community college faculty members (BCTC, ACTC) proposed and were selected for project awards. 2 community colleges became affiliates of the Space Grant program in 2014: Ashland Community & Technical College (ACTC) and Hopkinsville Community College (HCC).

- 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).

13 of 32 projects involve aeronautics research, from communications systems for unmanned aircraft to clustered flight of autonomous air vehicles.

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

5 of 32 projects involve research and activities for environmental science, from research and teacher workshops on remote sensing to high-altitude balloon flights to conduct atmospheric measurements.

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

17 of 32 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

The NASA Kentucky program has continued evolving program management with a focus on improvements in budget efficiency, data tracking, and communications. Partnerships have been expanded within the state, attracting new PIs from several affiliate institutions. Partnerships made in the past year include more involvement with KCTCS, the state's community college system, with the addition of Hopkinsville Community College, a 2-year MSI, and Ashland Community and Technical College, located in the underserved Appalachian region of eastern Kentucky, as affiliates. NASA Kentucky has assisted in transition of support for the annual Wing Design Competition from UK to the newly-renamed National Air & Space Education Institute (NASEI), as this organization for pre-college aerospace education has grown in the past year to have a full-time Director, expanded programming, and a new headquarters in Louisville.

## PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

### **Academic Affiliates**

Ashland Community and Tech. College	Community/Technical College
Bellarmino 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
Western Kentucky University	Public Comprehensive University

### **Non-Academic Affiliates**

Aviation Museum of Kentucky	Museum (STEM)
Innoviator, LLC	Industry
National Air & Space Education Institute	Non-Profit Organization
Kentucky Science and Technology Corp.	Non-profit Organization
Kentucky Science Center	Museum (STEM)
Kentucky Space, LLC	Industry
The Living Arts and Science Center	Museum (STEM)
Tribo Flow Separations, LLC	Industry