Kentucky Space Grant Consortium Executive Summary

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Kentucky Space Grant Consortium

Kentucky Space Grant Consortium (KYSGC) is led by the University of Kentucky (UK) and consists of 29 affiliate members, including 18 Kentucky higher education affiliates (universities, colleges and community colleges), 5 industry partners, and 6 STEM educational organizations. KYSGC programs engage participants in STEM education and training primarily at the post-secondary level, including developmental pipeline pre-college programs. Participation of the state's students and faculty, multiple academic disciplines and institutional types is essential and integral to success of the program. KYSGC is administered and hosted by the UK Department of Mechanical and Aerospace Engineering.

The primary goal of Kentucky Space Grant Consortium is to serve the needs of its stakeholders, develop expertise and expand capacity for aeronautics, space and science research and education in Kentucky. NASA Mission Directorate and NASA Office of STEM Engagement (OSTEM) alignment is integrated into all KYSGC programs. Three strategic themes chosen by the Consortium to help define KYSGC priority areas and align KYSGC projects with NASA Mission Directorates are ***Data + Science***, ***Earth + Space***, and ***Aerospace + Innovation***. Special focus areas to increase program impact in Kentucky include supporting mentorship and local focus, participation of students from rural and urban areas, and partnerships among Kentucky institutions.

KYSGC funding supports NASA and aerospace-related projects at higher education institutions across the state. A fundamental premise of KYSGC programs is that STEM education should inspire and recruit talent from all student populations to engage and enable innovative contributions to NASA and the National Space Grant College and Fellowship Program. KYSGC has worked with NASA Headquarters and each of the ten NASA Centers to implement projects in Kentucky. Kentucky's eight public universities and several KCTCS and private institutions have engaged with NASA-related research and educational opportunities through this program.

Past KYSGC support has provided Kentucky faculty and students opportunities to work on small satellite technologies, International Space Station missions, re-entry physics and hypersonic flight, robotics, aerospace design, and NASA internships. KYSGC programs continue to support projects in these areas, as well as high-altitude and spaceflight missions, astrophysics, electric aircraft, remote sensing, aerospace engineering and more.

Mission Statement

Kentucky Space Grant Consortium seeks to promote excellence in learning through advancement of expertise in aeronautics and space research, higher education and pre-college education in Kentucky, involving Kentucky citizens at all levels of the educational system and beyond through effective administration of impactful program opportunities. In fulfilling its mission, KYSGC serves multiple constituencies – NASA, the U.S., and Kentucky, including Kentucky's higher education faculty and students.

KYSGC Consortium Goals

Primary goal: Serve the needs of stakeholders and develop expertise and capacity for aeronautics, space and science research and education in Kentucky.

KYSGC contributes to STEM education in Kentucky by preparing students and teachers; maintaining a network of universities in Kentucky that contribute to aeronautics and space; encouraging collaborations among academia, industry, NASA and government agencies; supporting aerospace training, research and public outreach; and recruiting and training U.S. citizens, encouraging participation from all students. Consortium goals include:

1. **Effective Learning Opportunities**: Facilitate unique opportunities to attract and retain Kentucky students, enhance STEM education effectiveness in aerospace-related disciplines, inform the public, and engage with NASA and Space Grant programming.
2. **Workforce Training**: Advance Kentucky students toward STEM degree and career goals, including hands-on design, research and teamwork experience, and contribute to NASA missions and work, KY R&D, and the future workforce.
3. **Research & Development**: Provide crucial support for Kentucky faculty to engage in early-stage NASA-aligned research, mentor students, increase NASA collaborations, and pursue larger research awards that will expand the state's R&D enterprise.

Program Activities

KYSGC projects are competitively selected annually from proposals conceived and led by affiliate members under guidelines of KYSGC funding programs designed to serve NASA and Consortium objectives. Project topics and objectives are flexible, allowing affiliates to incorporate their own priorities and expertise, and address needs of constituents and stakeholders in their region. Individual award amounts vary by program, ranging from seed funding to significant student support. Innovation and collaboration opportunities are highly encouraged.

Links to NASA and KYSGC opportunities and a listing of previously funded projects are available on the NASA KY website at nasakentucky.org.

KYSGC Program Area 1: NASA Internships and Fellowships (NIF)

Support for post-secondary students is the primary objective of the NASA National Space Grant College and Fellowship Program. NASA seeks to promote science, technology, engineering and mathematics (STEM) education; encourage interdisciplinary training, research and public service programs related to aerospace; and recruit and train US citizens for careers in aerospace science and technology. NIF programs support hands-on NASA-aligned training, guided by Kentucky faculty and professional mentors in collaboration with NASA and Kentucky industry, serving to advance student knowledge and provide experience working in scientific and R&D settings with technical professionals in support of NASA missions and Kentucky priorities.

NIF Programs:

Graduate Fellowship (GF) and Research Experience for Undergraduates (REU) programs are designed to support independently conceived or designed research by highly qualified students, mentored by faculty advisors in disciplines needed to help advance NASA's missions.

NASA Center Internships (NCI) and Kentucky Aerospace Internships (KYAI) provide support for Kentucky students to gain practical experience in their fields, mentored by workforce professionals as an essential step towards their academic degrees. NASA internships are administered by NASA at nasa.gov/learning-resources/internship-programs.

KYSGC Program Area 2: Higher Education R&D

Funding in the Higher Education program element is designed to support competitive awards in multiple areas of resource needs for KYSGC affiliates, with a goal of attracting talented students to Kentucky institutions of higher learning, offering unique aerospace-related technical opportunities, and motivating students to excel and finish their degrees.

Higher Ed Programs:

Team Projects (TP) support faculty-mentored, multidisciplinary team experiences focused on authentic, hands-on research, design and technology development in science and engineering to inspire innovation, including participation in team engineering competitions, capstone design projects, and flight opportunities.

Research Initiation Awards (RIA) provide support for early-stage NASA-aligned research as an entry point to sustained NASA research collaboration, led by faculty who are establishing new research programs (early-career) or exploring new research directions into topics closely aligned with NASA priorities. Alignment with NASA interests and building meaningful collaborations with NASA scientists are essential to the development of competitive proposals for Federal funding opportunities. RIA projects help to initiate NASA partnerships, strengthen NASA connections and pursue increasingly challenging NASA-aligned research awards, develop collaborative research potential, improve proposal and research skills, and expand capacity and opportunities for student mentoring.

KYSGC Program Area 3: STEM Experience and Education

Education and outreach program elements include objectives to broaden the impact of KYSGC activities with support for projects led by Kentucky higher education institutions as well as KYSGC partners who provide pre-college, informal education and outreach activities, with goals to help fill the higher education pipeline with well-prepared, inspired and engaged students, motivated to pursue their degrees.

STEM Ed Programs:

Affiliate Program Grants (APG) support projects with sustainable, effective, evidence-based approaches to achieve beneficial outcomes for the Space Grant program and are designed to help realize well-defined programmatic objectives from KYSGC affiliate partners experienced in educational pre-college or higher education program development and aligned with Kentucky and NASA priorities for STEM education objectives, including pre-college outreach and recruiting, K-12 teacher training, support for student teams, and curriculum development.

Mini-Grants (MG) support pilot projects to develop program concepts, demonstrate outcomes and evidence-based educational practices, and make efforts toward project sustainability that can be developed into programs of larger scope. Mini-Grants support pre-college opportunities aligned with Kentucky and NASA priorities including STEM camps and competitions, K-12 teacher training, and museum-based astronomy and aerospace programs. Mini-Grants can also support higher education objectives for curriculum development, outreach and recruitment.

KYSGC Programmatic Focus Areas

Special focus areas to improve program impact in Kentucky include mentorship and local focus, participation of students from rural and urban areas, and partnerships among Kentucky institutions.

Mentorship and Local Focus

KYSGC goals support faculty to serve as mentors and role models for students in STEM fields, as this is known to be a key factor in encouraging students to pursue success in their education. KYSGC also encourages a local focus for projects and mentorship, with affiliate faculty engaging and recruiting students among their institution's student communities. The National Science and Technology Council's CoSTEM Strategic Plan of 2018 points out that teaching students a "growth mindset" can significantly improve academic outcomes. For this strategy, it is essential for mentors to be local (thus considered by students to be accessible and relatable) and at the same time also provide students with unique perspectives and knowledge about experiences beyond their local community.

Rural and Urban Areas in Kentucky

Rural areas are located farther from urban centers, and rural students may have more limited exposure to a variety of career paths, STEM experience and educational opportunities. KYSGC continues to focus on program opportunities for rural communities, leveraging the regional locations of different types of member institutions throughout the state and utilizing existing and expanding networks among the affiliates. Similarly, KYSGC recognizes the need for effective program opportunities for urban students in resource-limited areas as well.

Partnerships among Kentucky institutions

Five Kentucky KCTCS community colleges have joined the Consortium since 2014, located in both rural and urban areas. These colleges expand the composition of KYSGC institutional types and are important contributors to a network that reaches all areas of the state and more student populations. Students engaged in KYSGC projects at these schools have participated in on-campus programs and have successfully graduated and pursued 4-year degrees. Projects that partner community colleges with 4-year institutions are encouraged. Similarly, the delivery and effectiveness of KYSGC programming is improved by partnerships between multiple KYSGC affiliates and/or other Kentucky organizations, which are encouraged as well.

KYSGC Strategic Themes

Kentucky Space Grant Consortium strategic themes help to communicate aerospace-related priorities and opportunities across the Commonwealth to students, faculty and organizations engaging with NASA and Kentucky's growing aerospace industry sector. Affiliates annually propose for KYSGC funding and are competitively selected to conduct scientific research or educational projects of value to NASA's missions and work, as expressed by national NASA and Space Grant program objectives, as well as Kentucky and KYSGC program objectives, including technical focus areas expressed in the following strategic themes.

Strategic Theme 1: Data + Science (Multidisciplinary Data Science)
NASA Mission Directorate Alignment: ARMD, ESDMD, SOMD, SMD, STMD

Data science is central to the future of many research fields and investigators find themselves challenged with managing exponentially growing datasets. This is true for KYSGC Affiliates pursuing research in exo-solar discovery, space-based and ground-based astronomy, heliophysics, earth science, atmospheric science, meteorology, and AI/ML among others. Cybersecurity, secure communications and data fidelity are also topics of special concern due to widespread usage of data-collection sensors and peer-to-peer networking architecture. Training in data science methods can benefit students across disciplines. This theme captures the need to address data science in multiple NASA-related disciplines as well as interconnect and support Kentucky's growth in data science degree programs and high-performance computing applications, to establish additional NASA collaborations and engage use of NASA resources including large datasets. Data mining and analyzing NASA databases are recurring themes across many NASA opportunities. KYSGC projects that engage these pursuits will be better positioned to participate in new discovery and to compete for follow-on funding from NASA and other sponsors.

This theme has relevant topics to engage all KYSGC affiliates, including museums and science centers, businesses, community and technical colleges, and 4-year institutions. Related areas such as data visualization and virtual reality are informative tools to communicate technical concepts and enable younger students and the public to better understand scientific studies and results. Data science finds new relevance when associated with related tangible experience, therefore this theme encourages project concepts to associate data science with experiential approaches in which a hands-on component helps students better understand and engage with data science methods. Examples include data collection in conjunction with ground-based astronomical observations from Kentucky's several observatories or student-led flight projects such as UAVs or scientific balloons that fly data-collection instruments.

Strategic Theme 2: Earth + Space (Earth & Space Discovery)
NASA Mission Directorate Alignment: ARMD, ESDMD, SMD

NASA Space Grant programs offer Kentucky Space Grant Consortium affiliates the chance to engage in earth and space discovery like never before, with new opportunities fueled by growth of commercial spaceflight, development of the NASA Artemis and Gateway lunar programs, and satellite and flight-based research platforms that will enable Kentucky students and faculty to increasingly participate in space-related scientific missions and discovery at national and local levels. Many of these efforts can also be utilized to address challenges facing life on Earth. Geosciences, such as atmospheric science and meteorology, will continue recent advancements thanks to new approaches in remote sensing and data collection. Earth analogue studies can be used to help understand other solar system bodies and exoplanets, as studies of other planets and moons can be used to help understand Earth. Atmospheric flight missions offer Kentucky students the chance to be significantly engaged in scientific investigation with near-space balloon missions, UAV flight campaigns, parabolic aircraft flights, or sounding rocket launches that can serve as important technical experience for a student's academic career. Consortium pre-college efforts can be targeted towards the next group of college students to participate and learn. Opportunities exist as well for Kentucky students to participate in missions beyond Earth. Microgravity research is being utilized to develop new insight into the influence of gravity and understand fundamental physical phenomena. Spacecraft are being flown to study entry, descent and landing through

planetary atmospheres and to apply research of hypersonics and atmospheric fluid dynamics to improve thermal protection systems for spaceflight. Students can be involved with NASA's Artemis mission through internships and research fellowships, as well as with NASA's Lunar Gateway Program, lunar-related technology development and other lunar missions.

Strategic Theme 3: Aerospace + Innovation (Technology & Workforce Development)
NASA Mission Directorate Alignment: ARMD, SOMD, STMD

Kentucky's aerospace industry continues to grow along with the state's role as a national leader in aerospace manufacturing. In relation to the importance of Kentucky's aerospace manufacturing, more employees trained in advanced manufacturing skills are needed by the state's industries. Multi-disciplinary Kentucky Space Grant Consortium team projects are effective for motivating students at all levels to become involved in teamwork activities that pursue innovation and problem-solving, such as the NASA Human Exploration Rover Challenge and rocketry competitions. These opportunities engage students in a learning framework that contributes to student retention and degree attainment and that benefits the state's workforce needs. From pre-college STEM to post-secondary research and engineering careers, this theme brings together a common thread of engagement, innovation and enterprise that improves career readiness and workforce development at all levels. Internships contribute to this theme by allowing Kentucky students opportunities to increase their technical skill and workforce experience through the summer by working at one of ten NASA Centers nationally or with aerospace-related industries and labs within the state. Technology-focused research fellowships, performed in Kentucky university labs in collaboration with NASA personnel, support NASA's missions and work and contribute to the state's research and entrepreneurial activity in significant areas including hypersonics, advanced aerial mobility, electric aircraft, energy storage, materials science, robotics, artificial intelligence, human-technology interaction and more. These academic and internship experiences prepare students to contribute to aerospace workforce and technology sectors in support of KYSGC industrial affiliates, the state's employers, university research enterprises and new technology commercialization.

NASA Mission Directorates

ARMD - Aeronautics Research (aeronautics.nasa.gov/)
ESDMD - Exploration Systems Development (nasa.gov/directorates/exploration-systems-development)
SMD - Science (science.nasa.gov/)
SOMD - Space Operations (nasa.gov/directorates/space-operations-mission-directorate
STMD - Space Technology (nasa.gov/directorates/spacetech/home/index.html)

Kentucky Space Grant Consortium Affiliate Members

Kentucky Space Grant Consortium consists of 18 academic affiliates and 11 non-academic affiliates across the Commonwealth. Affiliate institutions and representatives are listed below.

Academic Affiliates

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