New Mexico Space Grant Consortium
New Mexico State University
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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 New Mexico Consortium is a Designated Consortium funded at a level of $575,000 for fiscal year 2011.

PROGRAM GOALS

New Mexico Space Grant Consortium (NMSGC) created new goals for our five year contract during the partnership meeting in May 2010. NMSGC Goals 2010-2014 include:

- Goal #1 – Marketing: Communicate unique NMSGC programs to local, state, and national leaders in STEM education and research.
- Goal #2 – Business: Enable commercial space industry development by highlighting NASA and NMSGC programs and capabilities.
- Goal #3 – Education: Take advantage of our unique geographic position and proximity to Spaceport America to provide a link to commercial launch opportunities for students and faculty.
- Goal #4 – Collaboration: Increase our collaboration with STEM education partners.

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

- Scholarship Program: Scholarship funding allows students to do NASA related research with faculty. The scholarship program supports students with observatory time, conference attendance, and allows them to publish their work. Students agree to 10 hours of community service when receiving their scholarship. The purpose of the service is to get students into the habit of giving back and to promote STEM recruitment, retention, and awareness. University of New Mexico (UNM) Mechanical Engineering scholar Amanda Luketa-Hanim said, "Participating in the Space Grant has inspired me to pursue independent research in subjects I am interested in (outside of the classroom), and has helped confirm my decision to go to

grad school." New Mexico State University (NMSU) Molecular Biology scholar Mark Seger said, "This past year, my participation in the NMSGC scholarship program has energized my excitement about research involving NASA, particularly in the area of planetary ecosynthesis. I was able to contact a well-known planetary scientist, Dr. Chris McKay, at NASA Ames Research Center. He provided a lot of current information about his area of expertise, which broaden my views on how my research in the area of plant molecular biology will impact how we may live in the future on earth and maybe on other planets. This program also helped me become more involved in the community. As I progressed through graduate school, I became very focused on being in the lab and volunteering has been a great outlet for me to get out and make a difference in the community."

- Internship Program: Internship programs are instrumental in retaining students through graduation. Research indicates students who work on real world applications through internships get a better understanding of how their academic work applies in the "real world." This proves to be a retention strategy. Internships allow students to work side-by-side with NASA and industry personnel and other interns. These experiences make students more competitive in the workplace. NMSU Mechanical Engineering student Daniel Wentzel interned at NASA's White Sands Test Facility and worked on carbon-epoxy composite micromechanical damage assessment using acoustic emission. Daniel said, "Space Grant gave me a wonderful opportunity to gain valuable work experience and an opportunity to pay for my schooling. Without this opportunity, this semester would have been financially difficult and it would not have been near as intellectually stimulating and fun. I had a fantastic semester thanks to Space Grant."
- Student Launch Program: The Student Launch Program provides annual access to space for student experiments. Students design, build, test, and fly experiments during a single academic year. Dakota Burrow said: "I'm a high school student and for a while I have known I wanted to be an engineer. The Space Grant Student Launch Program has allowed me to be involved in research and given me the opportunity to see what engineering is all about. Being involved broke the stereotype of what research was. It wasn't just a bunch of people in lab coats looking through a test tube. This program has gotten me interested in research and it confirmed my desire to be an engineer." NMSU Mechanical Engineering student Gerardo Martinez said, "I started as a psychology major and I didn't find it rewarding or challenging. I took an introductory engineering class and I learned to appreciate the true value of mathematics and physics. I did not want to restrict myself to keeping ideas on paper so engineering was a good fit for me. I walked into a lab as a volunteer and I got involved with the Space Grant Student Launch Program. Seeing the usefulness of the math and the physics we were learning in class was a motivation to learn the material so that I can contribute to the project. Since then I have been involved in recruiting other students so they can get the same benefit and motivation that I did."

PROGRAM ACCOMPLISHMENTS

- **Outcome 1: Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals through a portfolio of investments:**

- **Scholarship Program:**
  - SMART Objectives
    - 50% of participating students will be under-represented minority students
    - 50% female
    - 50% enrolled in minority serving institutions
    - 100% remain in their major through graduation
    - 100% complete 10 hours of community service
  - Accomplishments
    - 27% of participating students are under-represented minority students
    - 42% female
    - 86% enrolled in minority serving institutions
    - 100% of students receiving scholarships in 2011 are still enrolled
    - 70% completed community service (students are still enrolled and will complete service during current semester)
- **Internship Program:**
  - SMART Objectives
    - 50% of participating students will be under-represented minority students
    - 50% female
    - 50% enrolled in minority serving institutions
    - 100% remain in their STEM major through graduation
  - Accomplishments
    - 50% of participating students are under-represented minority students
    - 17% female
    - 100% enrolled in minority serving institutions
    - 100% are still enrolled
- **Research Enhancement Program**
  - SMART Objectives
    - All research funded will align with NASA Mission Directorates
    - All faculty receiving funding will publish at least one article or presentation of their results
    - 50% of awards will be made at minority serving institutions
    - All research funded by NMSGC will involve students
    - 100% of students receiving $5,000 or more to work with faculty will remain in the STEM major through graduation
    - 50% of participating students will be female and 50% will be minority
  - Accomplishments
    - All research funded align with NASA Mission Directorates:
      - Geomicrobiology of the Deep Biosphere study supports NASA’s Science Mission Directorate's study of the origin and early evolution of life on Earth.
      - Superconductor Gravity Experiment supports NASA's Space Technology Grand Challenges.
      - NMTSAT: New Mexico Tech Nanosatellite program supports NASA's Aeronautics Research Mission Directorate’s health

monitoring research.
    - Microstructure-Mechanical Property Relations for Cortical Bone and Microstructural Changes Related to Bone Loss supports NASA's priority to understand Human Health, Life Support and Habitation Systems as is described in NASA's Space Technology Roadmaps
    - Ruthenium Oxide Integration on Vertically Grown Graphene for Supercapacitor Applications supports NASA's Aeronautics Mission Directorate, developing supercapacitors for NASA Mission needs
    - How Galaxies Evolve: Testing the Hypotheses of Cold Flows and Stellar Feedback Winds in Early-Epoch Galaxies supports NASA's Science Directorate
    - Acquiring Nitrogen in the Subsurface: Implications for Understanding the Potential for Life on Other Solar System Bodies supports NASA's Science Directorate
  - All faculty receiving funding will publish at least one article or presentation of their results – all faculty presented articles at conferences.
  - 71% of awards were made at minority serving institutions
  - All research funded by NMSGC involved students
  - 100% of students receiving $5,000 or more to work with faculty will remain in the STEM major through graduation – all funded students are still enrolled.
  - 50% of participating students will be female and 50% will be minority - Three students were males and non-minority.
- **Student Launch Program:**
  - SMART Objectives
    - 50% of participating students will be under-represented minority students
    - 50% female
    - 50% enrolled in minority serving institutions
    - All capstone design courses will support NASA mission objectives
  - Accomplishments
    - 40% of participating students are under-represented minority students
    - 20% of participating students are female
    - 100% enrolled in minority serving institutions
    - Capstone design students created power bus and data bus for student experiments. Students will use this payload next year to provide power to their experiment and to provide data collection system for experiments.
- **Education Enhancement Program:**
  - SMART Objective: All courses will be part of the regular academic programs
  - Accomplishments:
    - A strain-gauge-based, internal balance systems for full 6-component force and moment measurement in the low speed wind tunnel was developed for Aerospace Engineering Aerofluids Lab
    - Developed a distance education course for Electronic and Computer Engineering Technology
    - Developed a Space Plasma Physics course as part of the new Space

Physics degree program
    - Developed a capstone design course to design payloads for flight vehicles
    - Developed curriculum in sustainable energy technology
- **Outcome 2: Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty:**
    - **Student Launch Program:**
        - SMART Objectives
            - 50% of participating institutions will be minority serving middle and high schools
            - 50% under-represented minority
            - 50% female
        - Accomplishments
            - 100% are minority serving middle and high schools
            - 83% under-represented minority
            - 0% female
- **Outcome 3: Build strategic partnerships and linkages between STEM formal & informal education providers that promote STEM literacy and awareness of NASA's mission:**
    - **Growing Community Partnership Luncheon (formally the Public Forum):**
        - SMART Objective: Public Forum contributes to the economic development of New Mexico's space economy.
        - Accomplishment: Purpose is to help local communities learn about the commercial space industry. Participants met the leadership of the global commercial space industry in the Commercial Space Exhibit Hall. Allan Lockheed Jr., son of aviation pioneer Allan Lockheed was our keynote speaker for the Community Partnership luncheon. He described how the commercial space transportation industry parallels the development of the airline industry. This event was sponsored by Steinborn TCN Commercial Real Estate. 100 people attended this event.
    - **Public Service Enhancement Program:**
        - SMART Objective –All NMSGC public service activities must support science, math, and technology, literacy
        - Accomplishments:
            - New Mexico BEST Program (Boosting Engineering, Science, and Technology) exposes middle and high school students to the concepts of engineering and technology through a robotics design challenge.
            - Outreach was provided in NASA related Sustainable Energy Technologies

PROGRAM CONTRIBUTIONS TO PART MEASURES

- Student Data and Longitudinal Tracking:
    - Total students tracked = 182; Scholarship awards = 140; Higher education = 42
    - 27% of total awards represent under-represented minority F/S funding. This is above the national average of 25% of STEM awards to minority students.

    - 52 students accepted STEM positions in an aerospace industry, NASA, or academic fields; 3 students have graduated and are pursuing advanced STEM degrees.
- Diversity:
    - Institutions: 66% of institutions are Hispanic Serving Institutions and 16% are Tribal Colleges
    - Faculty Participants: 20% are female
    - Student Participants: 20% are female and 44% are minority
- Minority-Serving Institutions:
    - New Mexico State University (HSI) is the lead institution for NMSGC. NMSU participates in our scholarship program, internship program, Research Enhancement Program, Education Enhancement Program, Student Launch Program, and Research Colloquium.
    - University of New Mexico (HSI) participates in NMSGC scholarship program, internship program, and Research Enhancement Program
    - Dona Ana Community College (HSI) participates in the Student Launch Program.
    - Navajo Technical College (Tribal College) participates in the Internship Program.
    - Eastern New Mexico University (HSI) participates in the Internship Program.
- NASA Education Priorities:
    - 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:
        - Scholarship Program: Scholarships provide funding for students to do NASA related research with faculty. Dr. Carl Agee recommended University of New Mexico Earth and Planetary Sciences student Kathleen Vander Kaaden for an NMSGC research scholarship. Kathleen is examining the density and compressibility of lunar volcanic glasses as a function of TiO2 content. The first phase of her project, on high-pressure density of Apollo 17 orange glass magma is nearly completed and she will soon be submitting the work for publication in a leading journal in planetary science. Kathleen already presented her work at the 42nd Annual Lunar and Planetary Science Conference. The second phase of her research focuses on the high pressure behavior of Apollo 15 green glass, to place new constraints on the origin and differentiation of the lunar interior. This project is funded through a NASA Cosmochemistry grant. Dr. Agee praised her progress and work ethic and believes she is right on track to have an exceptional Masters thesis and will go on to pursue a Ph.D.
        - Internship Program: Internships allow students to work side-by-side with NASA and industry personnel and other interns. Deryk Harder, New Mexico State University Mechanical and Aerospace Engineering student interned at Johnson Space Center working on two projects the Modular Instrumentation System (MIS) and the Parachute Test Vehicle (PTV) Aerodynamic Developmental Flight Instrumentation (DFI) Project (PADP). He was the

mechanical engineer in charge of design and manufacture of structures, including electromagnetic interference (EMI) shielding and other hardware.
    - Student Launch Program: Provides annual access to space for student experiments. Students design, build, test, fly, and analyze data for a flight experiment. On May 20, 2011 NMSGC launched 25 middle school, high school, community college, and university students' experiments to an altitude of 73 miles from Spaceport America. Data collected include radiation, temperature, pressure, velocity, video, and plasma measurements.
- 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: This priority is addressed by NMSGC through our Summer of Innovation Program.
- Community Colleges – develop new relationships as well as sustain and strengthen existing institutional relationships with community colleges: Students enrolled in an Aerospace Engineering Project Lead the Way dual credit course at Dona Ana Community College built an experiment and launched 73 miles to space in an UP Aerospace Rocket from Spaceport America as part of our Student Launch Program.
- 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):
    - New Mexico State University Mechanical Engineering students are building a suborbital flight experiment to validate a satellite inertia identification method. They have applied for a flight with NASA Flight Opportunities Program.
    - New Mexico Institute of Mining and Technology students are building a nano-satellite which will develop satellite health monitoring. Students are preparing a proposal for a flight as part of NASA's ELaNa Program.
- Diversity of institutions, faculty, and student participants.
    - Scholarship Program: recipients are 42% female and 27% minority.
    - Student Launch Program – Higher Ed: participants are 17% female and 50% minority
    - Student Launch Program – K-12: participants are 83% minority
    - 5 universities and community colleges are minority serving institutions
- Enhance the capacity of institutions to support innovative research infrastructure activities to enable early career faculty to focus their research toward NASA priorities: NMSGC made seven awards to faculty to help focus their research toward NASA priorities in the areas of biology, electrical engineering, and mechanical engineering at New Mexico Institute of Mining and Technology; physics, mechanical engineering, and astronomy at New Mexico State University; and biology and chemical and nuclear engineering at the University of New Mexico.

IMPROVEMENTS MADE IN THE PAST YEAR

- Public Forum: NMSGC changed the format for the Public Forum to a Community Partnership Luncheon. Participants met the leadership of the global commercial space industry in the Commercial Space Exhibit Hall and heard luncheon speaker Allan Lockheed Jr. This changed our target audience from middle school students in 2010 to the business community in 2011. This helped us meet our metric of contributing to the economic development of New Mexico's space economy.
- Research Enhancement: NMSGC did not award research funding in 2010 in an effort to focus proposed research on NASA priorities. NMSGC offered workshops to faculty at NMSU, UNM, and NMT to inform faculty about research priorities and increase the number of relevant proposals received. We funded seven research projects because of this workshop.
- Student Competition: NMSGC opened an opportunity for university student teams to request funding to participate in design competitions such as the NASA University Student Launch Initiative, NASA Reduced Gravity Student Flight Opportunities, NASA Lunabotics Mining Competition, AIAA Undergraduate Team Aircraft Design Competition, and the Student Launch Program. In 2011 NMSGC funded two teams to compete in the AIAA Undergraduate Team Aircraft Design Competition and NASA's Lunabotics Mining Competition.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

- Research Universities: New Mexico State University (HSI); University of New Mexico (HSI); New Mexico Institute of Mining & Technology
- Comprehensive University: Eastern New Mexico University (HSI)
- Community College: Dona Ana Community College (HSI); Navajo Technical College (Tribal College)
- Partners recruit and follow-up with scholarship students, recruit student interns, teach courses for the Student Launch Program, offer educational programs through the Education Enhancement Program, and research programs through the Research Enhancement Program.