

WV Space Grant Consortium
Lead Institution: West Virginia University
Director: Majid Jaridi, PhD
Telephone Number: (304) 293-4099
Consortium URL: nasa.wvu.edu
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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 West Virginia Space Grant Consortium is a Designated Consortium funded at a level of \$575,000 for fiscal year 2013.

PROGRAM GOALS

The NASA West Virginia Space Grant Consortium (WVSGC) mission is to enhance educational programs and research in the fields of Science, Technology, Engineering and Math (STEM) in the state of West Virginia (WV). An important goal of WVSGC is to capture, channel, and enrich the activities of the current and potential scientists as well as engineers through the Consortium's affiliate member's network, with special emphasis to increase the participation of under-represented groups in our programs. Our intent is to extend the benefits of NASA's research and education to all citizens of WV and to promote and support STEM education in the state.

Five goals provide the nexus of our WVSGC mission statement. To address each of these goals, the WVSGC provides in the following information specific, measurable, attainable, realistic, and timely (SMART) objectives within each NASA related Outcome.

Outcome 1

Fellowship/Scholarship Programs

Goal: To contribute to, and advance NASA's vision and strategies as outlined in various NASA documents, specifically in terms of workforce development.

SMART objectives:

- To maintain the minimum number of Space Grant fellowships/scholarships at

- 120 per year;
- To place at least ten summer interns at NASA field centers (including the Academies) and high-technology companies in WV; and
 - To increase the number of students who benefit from our Fellowship/Scholarship and summer internship programs by 5% per year in the next five years (assuming the availability of at least the same level of funding).

Higher Education Programs

Goal: The goal of WVSGC's Higher Education Program is to enhance higher education capabilities in STEM in WV. WVSGC is in a unique position to initiate and support innovative programs that enable WV students to engage in hands-on experiences that will better prepare them for careers at NASA, its contractors, and other high-technology companies in the US.

SMART objectives:

- To initiate and support programs such as the Balloon Satellite Project, Microgravity Research Program and to participate in programs such as RockOn that have been made available through other Consortia;
- To insure sustainability by securing at least 1:1 cost share from participating affiliates for the above higher education programs;
- To provide partial support to special projects of student organizations such as American Institute of Aeronautics and Astronautics (AIAA), Society of Women Engineers (SWE), National Society of Black Engineers (NSBE), Astronomy Club, and Student Partnership for the Advancement of Cosmic Exploration (S.P.A.C.E.); and
- To support at least two new STEM courses per year at undergraduate and graduate levels at WVSGC academic affiliates.

Research Infrastructure Programs

Goal: To contribute to NASA's and the state of WV's efforts at research infrastructure development (particularly in the high-technology sector).

SMART objectives:

- To support new faculty members at our academic affiliates through seed grants and assistance in building collaborative efforts with a NASA scientist. We will make at least 20 seed grant awards per year; and
- To help and support all faculty members at our academic affiliates to initiate collaborative research with the high-technology sector in WV. We will support at least two such projects per year.

Outcome 2

Goal: To support the development of innovative STEM related courses/activities and participation in professional development opportunities at the pre-college level.

SMART objectives:

- To support programs that enhance the use of NASA-developed training programs at the secondary education level for teachers in WV. We will fund at least two such projects that would support STEM teachers to attend professional development opportunities (at least 10 teachers per year); and
- To support in-service and pre-service teachers to implement programs that would stimulate the interest of pre-college students in STEM areas. We would like to support at least two teachers (or teams of teachers) to implement such programs to cover a minimum of 50 students per year.

Outcome 3

Goal: To support the development of new and innovative extension and outreach programs such as conferences that promote the understanding, education, development, and utilization of space; seminars that encourage inter-disciplinary training and informal education activities for the general public in WV.

SMART objectives:

- To support and fund at least two projects in public extension and outreach per year;
- To be proactive in conducting collaborative public extension programs with our partners and various entities in the state; and
- To reach as many members of the public in WV as possible and enhance their understanding of the importance of STEM education, as well as the positive role NASA plays in high-technology workforce development. We aim to outreach to at least 1,000 members of the public in WV.

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

Outcome 1: (*Employ and Educate*)

In 2013 WVSGC provided numerous opportunities for students at its academic affiliates as well as the opportunity to participate in summer internships at NASA centers and high-technology companies in WV. Overall 17 students (7 female, 10 male; 24% minorities) interned at various NASA centers or high-technology companies or summer research internship with science and engineering faculty in the summer of 2013. They represented nine academic departments and five institutions of higher education in WV.

Ashley Rachelle Webb, currently a sophomore at Fairmont State University majoring in National Security and Intelligence, Political Science, and Criminal Justice with minors in Spanish and History, was a recipient of a WVSGC sponsored summer internship at

Wallops Flight Facility. She graduated from Pocomoke High School in 2012 with a 5.12 GPA. In her final internship report submitted to WVSGC, Ashley wrote: “(the) NASA Wallops Flight Facility was a wonderful place to work, between the excitement of the rockets and airplanes to the interesting and diverse group of people that I got to interact with daily, I could not imagine a better career choice. During my internship I met many new people, learned new things, and expanded my horizons both socially and educationally. I am grateful for the opportunities that this internship gave me, it was both educational and fun which is something many students do not have the chance to experience. These internships present so many opportunities that I encourage others interested in Science, Technology, Engineering, and Mathematics (STEM) fields to apply. During high school I was actively involved with FIRST Robotics and served as team captain for two years, along with being actively involved with Pocomoke High School’s MESA (Mathematics, Engineering, Science, Achievement) team. I hope to one day, after I graduate from Fairmont State University, be employed in a place where I can use the knowledge I have learned during my internship at NASA and from my education. I hope to make a positive lasting impact on not only my community but also on my country.”

Higher Education Programs

As a direct result of the WVSGC higher education program, many positive comments, such as the following, were submitted to the National Space Grant Foundation (NSGF) as part of our longitudinal tracking program. The comments are from students who were supported during FY13.

Question: How did participation in these programs impact your education and life?

Answer: “The Space Grant allowed me to have some great opportunities which would not have been possible otherwise. The Space Grant program directly lead to my NASA internship and goal of becoming a NASA engineer.” (Timothy Godisart - 03/19/12, 2011 Lunabotics Mining Challenge, 2011 WV Space Grant Higher Education Program, 2012 Lunabotics Mining Challenge, 2013 Mars Mining Competition, West Virginia University (WVU) - Research Assistant)

Research Infrastructure Programs

Dr. Teresa Faykus, West Liberty University, was a recipient of one of our Research Enhancement Awards to work on a project entitled: “Heart Failure Readmission Reduction Strategies: Patient Education Focus.” She actively engaged five female undergraduates (Jessica Bell, Melanie Haddox, Heather Hyre, Sarah Kasserman and Katelyn McGowan) to work with her on this research. Dr. Faykus also presented her research at the 25th Annual Greater Pittsburgh Nursing Research Conference, October 25, 2013 where she provided an opportunity for nurses to learn the mechanics of the research process through interactions with experienced nurse researchers.

Outcome 2: (Educate and Engage)

WVSGC sponsored several education projects that benefited the Consortium students directly and prepared them for a STEM career in the future.

- 1) WVSGC sponsored the annual WV FIRST LEGO® League state championship on the campus of Fairmont State University. Todd Ensign, NASA IV &V Educator Resource Center program manager, reported: “the 14th Annual WV FIRST LEGO® League (FLL) Tournament is again the largest ever with more than 60 teams from across WV participating and over 1,200 students, coaches, and parents attending the tournament. There are also 100+ scientists, engineers, and aerospace professionals from NASA IV&V Facility, Fairmont State University, WVU, and local companies along with high school and college students serving as judges, referees, and volunteers. This is the single largest science, technology, engineering and mathematics (STEM) competition hosted in the mountain state, and one which continues to bring the brightest young minds together for a celebration of learning, helping others, having fun, and of course. . . robotics”.
- 2) College level robot competition:

NASA's Fifth Annual Robotic Mining Competition. The Lunabotics team, which includes students from a variety of disciplines in the Benjamin M. Statler College of Engineering and Mineral Resources and the Bluefield State College (a minority serving affiliate of WVSGC) along with cadets from WVU’s United States Air Force ROTC, participated in the competition at the Kennedy Space Center. For the third straight year, WVU finished near the top. The Mountaineers took second place in the competition for the coveted Joe Kosmo Award for Excellence, which honors the team earning the most points overall in the competition. (14 students, 1 female, 13 male, 10 undergraduates, 4 graduates)

NASA Centennial Challenge: Sample Return Robot. Faculty mentor Dr. Yu Gu is mentoring ten WVU students preparing to compete in this challenge. The team is building a robot that can autonomously navigate a natural terrain and collect specified samples in two time phases. The challenge will be held at Worcester polytechnic Institute in Worcester, Massachusetts. (9 male, 1 female, 7 undergraduates, 3 graduates.)

Revolutionary Aerospace Systems Concepts Academic Linkage (RASC-AL) Exploration RoboOps or Mars Rover Competition. In this exciting competition, undergraduate and graduate students were invited to create a multi-disciplinary team to build a planetary rover prototype and demonstrate its capabilities to perform a series of competitive tasks in field tests at the NASA Johnson Space Center’s Rock Yard (20 students, 3 female, 17 males, 15% minority participation.)

Outcome 3: (Engage and Inspire)

WVSGC sponsored several public extension and outreach projects last year. A couple of those projects are highlighted below.

- 1) “3D Printing Roadshow for NASA Outreach”, Erica Gilkeron, Principal Investigator. The Robert C. Byrd Institute (RCBI), June Harless Rural Educational Center and Marshall University launched this NASA WVSGC Extension and Public Outreach project to expose students and educators to the unlimited possibilities of 3D printing with a focus on using 3D printing technology in the Vision for Space Exploration.

The project targets goals that expose students and educators to the technology in three events: 1) “RCBI’s Dimension 1200es 3D Printer on the road.” A design engineer demonstrated the 3D printer for local high schools and vocational schools in order for the students to actually see how the 3D printing works, 2) hosted a 3D Printing Open House/Tour at RCBI South Charleston and invited students, educators and companies to see the different types of 3D printers, how they are used in different industries, including aerospace, and get an introduction to the software; and 3) sponsored a “Vision for Space Exploration” 3D Design Competition. Students from across the state were eligible to participate by submitting an original 3D design that supports the “Vision for Space Exploration” theme. Direct interactions of participants are listed below:

- Middle School teachers: 15
- High School teachers: 20
- Informal Educators: 5
- High School Students: 180

- 2) WVSGC provided informal education activities for the general public in WV by participating in events such as the WV State Fair held August 8-17, 2013. In collaboration with NASA Langley Research Center, NASA IV&V Facility and WVU Freshman Engineering, we staffed an interactive exhibit during the course of the fair. Over 3,200 people visited the WVSGC’s booth.

PROGRAM ACCOMPLISHMENTS

Outcome 1: (Employ and Educate)

Achievements and progress related to the NASA WV SGC Fellowship/Scholarship, Higher Education and Research Infrastructure program are listed below.

Fellowship/Scholarship Programs:

SMART objectives:

- 1) To maintain the minimum number of Space Grant fellowships/scholarships at 120 per year.
- 2) To place at least ten summer interns at NASA field centers (including the

- Academies) and high-technology companies in WV; and
- 3) To increase the number of students who benefit from our Fellowship/Scholarship and summer internship programs by 5% per year in the next five years (assuming the availability of at least the same level of funding).

Accomplishments for FY 2013 per SMART objectives:

- 1) WVSGC met our goal and exceeded the projected minimum number of fellowships and scholarships. We made 146 fellowship/scholarship awards (\$1,000 to \$3,000 each) as well as fourteen (14) Undergraduate Research Fellowships (up to \$5,000 each) and six (6) Graduate Fellowships (\$24,000 each).
- 2) WVSGC surpassed the original goal with a total of 17 students supported for summer internships.
- 3) In FY 2012, WVSGC sponsored a total of 133 awards. In FY 2013, 163 students were sponsored. This represents an increase of 22% which is by far greater than our objective of increasing our fellowship/scholarship awards by 5% per year.

Statistics for students who have taken their next step and have been successfully tracked through their next step vs. last year of SG support are shown below.

- 102 students took the next step in FY13 (SG participation supported from FY06-FY13 funds)
- 32 are pursuing advanced degrees in STEM disciplines
- 1 is seeking a STEM position
- 3 accepted STEM positions at NASA contractors
- 28 accepted STEM positions in industry
- 4 accepted positions at NASA
- 8 accepted STEM positions in academia
- 26 went on to positions in non-STEM disciplines

Higher Education Programs

SMART objectives:

- To initiate and support programs such as the Balloon Satellite Project, Microgravity Research Program and to participate in programs such as RockOn that have been made available through other Consortia;
- To insure sustainability by securing at least 1:1 cost share from participating affiliates for the above higher education programs.
- To provide partial support to special projects of student organizations such as AIAA, SWE, NSBE, Astronomy Club, and Student Partnership for the Advancement of Cosmic Exploration (S.P.A.C.E.) ; and
- To support at least two new STEM courses per year at undergraduate and graduate levels at WVSGC academic affiliates.

Accomplishments for FY 2013 per SMART objectives:

- 1) WVSGC sponsored several higher education projects that benefited our STEM students directly and helped them to get ready for a future in STEM career.
 - Reduced Gravity Education Flight Program/ Microgravity Research Program. Co-sponsored travel support for 21 students (1 female, 20 males, 1 minority) to attend the student competition.
 - NASA Connecticut Space Grant Consortium Helicopter Training Experience in New Britain, Connecticut. WVSGC sponsored two students, Vasyl Shtanko from Shepherd University and Wes Gosselink from WVU Institute of Technology to attend the workshop. During their one week stay, the students toured the facilities of Sikorsky and KAMAN Aerospace. The students were able to experience a helicopter flight simulation as well as learn about helicopter aerodynamics and VTOL aircraft design construction techniques. Mr. Shtanko stated that one of the greatest things about the workshop was being able to network with other engineers and learn from them about design strategies and manufacturing principles. Mr. Gosselink detailed his experience as being “amazing to learn about the physical principles and then practice it in such a dramatic fashion.”
 - SAE Collegiate Engineering Design Competition. Co-sponsored travel support for the team of 27 students, consisting of five females and 22 males ranging from the sophomore to senior level to attend the competition.
- 2) WVSGC met its goal and sustained a 1:1 cost share from the sponsoring institution for the Higher Education programs.
- 3) WVSGC reached its goal and sponsored several special projects for students and student organizations. The programs include: Support for AIAA; SWE; IIE; support for two students (one each from WVUIT and SU) to attend the NASA Connecticut Space Grant Consortium Helicopter Training Experience in New Britain, Connecticut; support for Career Fairs (Statler College of Engineering at WVU, high-technology companies, and NASA IV&V Facility) which were attended by over 100 employers and over 2,500 students; and support for NASA Scholars to attend conferences to present their research papers.
- 4) We achieved our goal in the number of new STEM courses offered. Two College Course Development proposals were funded in FY 2013. Dr. Yu Gu, WVU, “Development of an Undergraduate Course in Mobile Robotics,” and Dr. Venkat Gudivada, Marshall University, “Exploring the World with Computing.”

As a direct result of the WVSGC higher education programs and WVSGC scholarships, the following comment by a student who was supported during FY13 was recently submitted to the National Space Grant Foundation (NSGF) as part of its longitudinal tracking program.

“Much has happened since last summer. I am now an aerospace engineer civil servant working on distributed air/ground air traffic management concepts at NASA Langley Research Center. I have one publication that was presented at the USA/Europe Air Traffic Management Research and Development Seminar (ATM2013) and another that will be presented at the AIAA ATIO conference coming up later this year. Both papers are related to the summer project that I worked on last year, and I am continuing research on the same topic as part of my full-time job. I miss the mountains...very flat down here at Langley. (Matthew Underwood - on 06/26/13, 2012 NASA Academy, NASA/Langley Research Center - Research Aerospace Engineer)”

Research Infrastructure Programs:

SMART objectives:

- To support new faculty members at our academic affiliates through seed grants and assistance in building collaborative efforts with a NASA scientist. We will make at least 20 seed grant awards per year; and
- To help and support all faculty members at our academic affiliates to initiate collaborative research with the high-technology sector in WV. We will support at least two such projects per year.

WVSGC supports two programs in this category and the accomplishments for each SMART objective are listed below:

- Research Initiation Grants (RIG) are competed for at the Consortium level. These grants are awarded in the amount of (up to) \$20,000 of NASA funds augmented by \$10,000 in cost share. Two RIG’s were awarded last year.
- Research Enhancement Awards are competed for at the academic affiliate level. WVU, the lead institution, does not participate in this program. Per an annual subcontract, each affiliate receives \$6,000 in NASA funds which they augment by an additional \$6,000 from non-federal sources. Issuing the RFP, deciding on review criteria, and making the award decisions are accomplished by the NASA Committee at each affiliate independently. 39 seed grant awards were made in 2013. (14 female, 25 male)

The breakdown of the number of Research Enhancement Awards (REA) made to the faculty at the time of this report during the FY2013 reporting period by affiliate is as follows:

Bethany College	3
Fairmont State University	2
Glenville State College	5
Marshall University	9
Shepherd University	6
West Liberty University	3

WV State University (MSI)	6
WV Wesleyan College	2
Wheeling Jesuit University	<u>3</u>
Total REA awards:	39

The following Research Initiation Grant awards were made during FY 2013 reporting period.

- 1) Dr. Xian-An Cao, WVU, “Ultrahigh Sensitivity Infrared Photodetectors Based on Nanocrystal Quantum Dots for Space Applications.”
- 2) Dr. Joseph Horzempa, West Liberty University, “The use of genetically modified *Francisella tularensis* LVS as a novel live vaccine platform.”

Outcome 2: (*Educate and Engage*)

SMART objectives:

- To support programs that enhance the use of NASA-developed training programs at the secondary education level for teachers in WV. We will fund at least two such projects that would support STEM teachers to attend professional development opportunities (at least 10 teachers per year); and
- To support in-service and pre-service teachers to implement programs that would stimulate the interest of pre-college students in STEM areas. We would like to support at least two teachers (or teams of teachers) to implement such programs to cover a minimum of 50 students per year.

WVSGC has supported and implemented a competitive program in direct support of Outcome 2: the K–12 Professional and Curriculum Development Program. The program was formed to enhance the interests and enthusiasm of K-12 students and teachers in science, math, and engineering. Intended for teachers, schools, or non-profit organizations to design and implement K-12 professional development projects or new curricula for the academic year. The main emphasis is on teacher development, not class activities.

The accomplishments for each SMART objective and projects supported in this category during FY 2013 reporting period were:

Dr. Afrin Naz, Virginia University Institute of Technology, “Collaboration for student success in STEM fields.” Dr. Naz introduced an innovative project designed by the Department of Computer Science and Information Systems and the Department of Mathematics at West Virginia University Institute of Technology with the help of local high school teachers to place a strong emphasis on addressing the current and anticipated shortfall of STEM professions. In her efforts, Dr. Naz has established communication channels with Raleigh County School District, Kanawha County School District, and

Putnam County School District. Twenty five (25) in-service educators and three college faculty participated in this program.

Dr. Robert Strong, Near Earth Object Foundation, “Science Fair 101 Project”. The project comprised of a one day summer workshop and two follow up sessions for middle and high school science teachers. The sessions were led by members of the Near Earth Object Foundation, SMART-Center staff, and the WV-Handle on Science Project Director. Thirty seven (37) public and private school teachers of 6-12 grade students from Brooke, Hancock, Marshall, Ohio and Wetzel counties attended the workshop.

Dr. Elizabeth Strong, Near Earth Object Foundation, “Elementary Engineering Workshop.” This project comprised of a three day summer workshop and two fall follow-up sessions led by members of the Near Earth Object Foundation, SMART-Center staff, and the WV-Handle on Science Project Director. The workshop focused on engineering activities that may be used in K-8 science classrooms. 15 teachers of K-8 students from Brooke, Hancock, Marshall, Ohio and Wetzel counties participated in the program. The teachers of grades K-4 or K-5 serve an average class size of approximately twenty students annually. In grades six and above, teachers may teach over one hundred and fifty students per day. An estimate of the number of students impacted in the first tier of this projects is over one thousand, with over one half of the participants targeted in grades K-5 and the remainder from grades six and above. In terms of the evaluation mechanisms, in addition to the pre and post-tests that were administered during the summer session, conversations regarding the questions that were missed on the post-test occurred during the required fall follow up session. Science content knowledge was gained based on the results of the pre vs. post-tests, with many of the participants. The success of the project was evaluated in terms of 1) level of interest and participation of teachers; 2) level of support from county school systems for implementation; and 3) the value of reporting the institute for another group of teachers and soliciting funding for additional workshops. Lesson plans were shared at the fall follow-up sessions.

We are continuing our partnership with NASA IV&V Facility in the project called “Space Flight Design Challenge: Mission OC-Flight 1.” Space Flight Design Challenge is an initiative focused on enhancing critical systems education, the tools and methods of IV&V (Independent Verification & Validation), and systems and software engineering approaches in general. The Space Flight Design Challenge pushes the envelope of education and engages students in STEM disciplines needed to successfully build and test complex and critical systems. The Space Flight Design Challenge is a collaborative partnership among NASA's IV&V Program, industry, academia, and other government agencies to foster innovative advancements in the application of IV&V while enhancing the knowledge and capabilities of the public through hands-on spacecraft development. Using an incremental approach, teams comprised of both college and high school students across West Virginia and eventually the nation will compete in building, testing, launching and operating flight systems in low Earth orbit through amateur radio operations. Academic institutions that have been incorporated into the program include: Shepherd University, West Virginia Wesleyan College, West Virginia, and West Virginia

Institute of Technology. At these institutions, “Student Partnerships for the Advancement of SPACE” (S.P.A.C.E.) chapters have been established as well.

As a direct result of the WVSGC program, the following comment of note was recently submitted to the National Space Grant Foundation (NSGF) as part of its longitudinal tracking program.

Question: What role have you played in the aerospace industry since graduation?

Answer: I have invited professional speakers into my classroom from the aerospace industry. They taught my students about aerospace careers and the science behind flight. (Mary Dolan - on 08/22/13, 2005 West Virginia Space Grant Scholar, Ohio County Schools - Teacher)

Outcome 3: (*Engage and Inspire*)

SMART objectives:

- To support and fund at least two projects in public extension and outreach per year;
- To be proactive in conducting collaborative public extension programs with our partners and various entities in the state; and
- To reach as many members of the public in WV as possible and enhance their understanding of the importance of STEM education, as well as the positive role NASA plays in high-tech workforce development. We aim to outreach to at least 1,000 members of the public in WV.

NASA WV Space Grant Consortium implemented a competitive program entitled “West Virginia Space Grant Consortium Extension and Public Outreach (EPO) Grant” program.

A brief description of accomplishments and projects supported in 2013 is provided below:

Dr. Tracey DeLaney, WVWC, “WV Skies: Wild and Wonderful.” Dr. DeLaney has designed a series of activities to meet the needs of local elementary and middle school teachers to be used in the WVWC 40-seat planetarium. She reported that in her project they had interaction with 10 Elementary School Teachers, 9 Middle School Teachers, 125 Elementary School Students and 86 Middle School Students.

Dr. Deb Hemler, Pierpont Community College, “WV FIRST LEGO League (FLL) Competition.” The FLL program in WV this year recruited 69 teams to participate in the program. For the first time in FLL history, they solicited private companies for additional financial support to provide the winning team a \$2,250 check to off-set any travel expense they will incur when representing WV at a national or world event in the spring. Finally, the largest accomplishment beyond hosting the largest and most successful FLL

in the 14 year history of WV was the announcement of the move to official qualifiers next year at five partner organization sites across the state. FLL has a bright future in WV due to the continued support of the Space Grant Consortium.

Ashley Martucci, “TEKids.” This project is an afterschool enrichment program which serves and connects the community by providing STEM workshops to K-5th grade children, teacher training and development, and student mentorship. Through community partnerships, community-focused curriculum is designed and implemented through learning by discovery techniques, cutting edge technology, and computer applications. Summer sessions were offered in 2013. The classes offered were Rocket Scientists and Data Miners. TEKids taught 45 students during these sessions. In fall 2013, TEKids offered the Marketeers class. 200 students participated in the fall session. In spring 2014, the Grow-Boticists class was offered, and 200 are scheduled to participate in this session.

Erica Gilkerson and Tom Minnich, Marshall University, “3D Printing Roadshow for NASA Outreach” “Additive manufacturing” or “3D Printing” technology has become the new revolution in advanced manufacturing and on the radar for advances in just about every industry including aerospace, the military and defense, biometrics, energy and automotive. The business of 3D printing versus traditional manufacturing has become so lucrative that 3D printer manufacturers are now making smaller versions that can easily fit into the classroom or the kitchen counter. The Robert C. Byrd Institute (RCBI) June Harless Rural Educational Center and Marshall University Research Corporation launched this Extension and Public Outreach project to expose students and educators to the unlimited possibilities of 3D printing with a focus on using 3D printing technology in the Vision for Space Exploration.

Elizabeth Strong, Near Earth Object Foundation, “Space Rocks.” This project draws from the recent astronomical news to build and continue interest in aerospace science and education. The *Space Rocks* project delivered eighteen (18) sky-based events and six (6) public lectures within selected communities and parks in the WV counties of Brooke, Hancock, Marshall, Ohio, and Wetzel. Each of the planned *Space Rocks* events brought space and sky related topics to life via regional expert speakers giving multimedia interactive presentations on meteors, meteorites, asteroids, comets, and “NEOs” in addition to the space-related topics of the day. There were 30 hands-on student activities supported by this project

Dr. Robert Strong, Near Earth Object Foundation, “10 Closest Star Systems Project.” This project addresses the need by the general public to better understand the stars - not the locations of stars, nor the myths and legends associated with the constellations, but information about the actual stars. This project provides informal educators and students participation with the following existing NASA-sponsored projects: NASAs WISE Mission; NASAs PlanetQuest Website; NASAs Kepler Mission, NASAs New Horizon Mission, Nearby Stars Database (NStars) and NASA Institute for Advanced Concepts. *The 10 Closest Star Systems* project will deliver twenty-two (22) StarWatch events with two goals. 1) To show attendees as many of *The 10 Closest Star Systems* as can be seen

from Wheeling, WV area. 2) To create with attendee feedback a draft in book and e-book form *The 10 Closest Star Systems*.

Additional projects sponsored by WVSGC included the following:

- 1) 2013 Eighth Grade Career Day at Mylan Park in Morgantown, WV.

The annual “8th Grade Career Day”, held every spring, encourages 8th grade students to start considering their career path as they prepare to graduate to High School. Almost 800 students from Monongalia County attended the event in 2013. Professionals from a variety of North-Central WV businesses prepared educational activities and instructional materials for students of Monongalia and surrounding counties. The WVU Lunabotics team demonstrated a variety of robots to show students how the STEM fields can be employed in real-world applications. Students were engaged, asking how robots are built, how long it takes, and most importantly, what steps they needed to take as they progressed through their education to participate in robotic development projects. Also on display was the Van DerGraaf generator where students were enthusiastic to see how “shocking” static electricity worked!

- 2) West Virginia Space Public Outreach Team (WV SPOT)

Supported through a joint partnership between the National Radio Astronomy Observatory, NASA IV&V Facility and the WVSGC, the West Virginia SPOT recruits and trains college presenters to bring presentations about current WV space science, technology, and engineering to WV K-12 classrooms, museums, and youth programs. In the summer of 2013, representatives from NRAO Green Bank, WVSGC, and the NASA IV&V Facility, convened to discuss how to highlight WV’s on-going and world-class contributions to astronomy and space sciences by leveraging after a model program in Montana called the Space Public Outreach Team (SPOT). SPOT recruits and trains undergraduate presenters from all majors to deliver NASA-themed presentations to K-12 schools and organizations throughout the State.

At the first official student training session, 19 students from five institutions traveled to Morgantown, WV, to receive training from Dr. Kathryn Williamson from the NRAO, and Justin Smith from NASA IV&V Facility. The next scheduled student training session was held at the NRAO Green Bank site in Green Bank, WV. Even though the training was held during the winter recess for WV schools, 11 students representing four institutions traveled to the NRAO site.

Two presentations were developed and are currently being offered for the 2013-14 academic year, as follows:

- **The Invisible Universe** presentation explores what scientists have learned about the universe by catching and analyzing invisible messengers from space: radio

waves and gravitational waves. These invisible messengers help us learn about what happens when a star explodes, radio light houses in space called pulsars, and colliding stars and black holes that causes ripples in space. The show highlights the world-class National Radio Astronomy Observatory facility in Green Bank, WV, in addition to the North American Nanohertz Observatory for Gravitational Waves, co-founded by physicists at WVU.

- **Mars: Past, Present, Future** is a SPOT presentation that explores what it takes to design a successful mission to Mars. Past, present, and future missions rely on NASA scientists and engineers to test their designs. Students in WV can learn about satellite and rover design at the NASA Independent Verification and Validation center in Fairmont, WV with support from the WVSGC.

PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE MEASURES

- **Student Data and Longitudinal Tracking**

Total awards = 193; Fellowship/Scholarship = 145, Higher Education/Research Infrastructure = 48; 15 of the total award represent underrepresented minority fellowships/scholarships funding.

According to our FY13 longitudinal tracking report, 32 students are pursuing advanced degrees in STEM disciplines, 1 is seeking a STEM position, 3 accepted STEM positions at NASA contractors, 28 accepted STEM positions in industry, 4 accepted positions at NASA, 8 accepted STEM positions in academia, and 26 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:**

WVSGC continued its support of the Emerging Leaders Institute (ELI) at Bluefield State College. The goal of this program is to recruit and train minority college students in STEM fields to be mentored by a faculty member. These students visit area high schools and talk to minority students to encourage them to attend college and serve as a role model for them. ELI was established at Bluefield State College several years ago to provide African-American students majoring in STEM fields with opportunities for leadership development through a comprehensive program based in leadership theory and practice. The program stresses civic service and academic productivity, while stressing ethical responsibilities of individuals and organizations.

Additionally, two Bluefield State College students, Sasha Richmond and Samuel Dennah, participated in the WVSGC sponsored Higher Education program, NASA's Fifth Annual Robotic Mining Competition. Sasha and Dennah traveled to WVU to

receive training from ROTC Cadet J. Perrine on the use of the *Lego Mindstorm*. Once certified, they organized and lead STEM related outreach activities for high school students in Bluefield, WV. In their demonstrations they showed their skills using the *Lego Mindstorm*. The *Lego Mindstorms* series of kits contain software and hardware to create customizable, programmable robots.

As a direct result of the WVSGC program, the following comment of note was recently submitted to the National Space Grant Foundation (NSGF) as part of its longitudinal tracking program.

Question: How did participation in these programs impact your education and life?

Answer: “West Virginia Space Grant played a very influential role in my education. The grant helped me strive to do better with my education. Because of the positive and motivating people I was involved with because of the grant, I managed to graduate with a 3.06 GPA.” (Sylvia Taylor, Bluefield State College - on 06/19/13, 2008 West Virginia Space Grant Scholar, 2009 West Virginia Space Grant Scholar, 2010 Higher Education: Emerging Leaders Program, 2010 WV Space Grant Affiliate Fellowship, RES-CARE INC - Service Coordinator)

- **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.
 - The “West Virginia Rocketeers” is a program sponsored by WVSGC. Student teams were advised by Dr. Dimitris Vassiliadis (male), WVU Physics Department, and Dr. Tracey Delaney (female), WVWC Department of Physics and Engineering to participate in the RockSat research and education project which provides a space-based platform for payloads built by students with a variety of backgrounds and levels of expertise. This project is targeted to STEM majors from the Eberly College of Arts and Science, Statler College of Engineering and Mineral Resources and West Virginia Wesleyan College. The objective of the WVU RockSat mission was to measure the density of electrons as a function of altitude. The goal of WV Wesleyan College team was to measure the variations in magnitude of Earth’s magnetic field over the course of the rocket’s flight using an IMU sensor. Team Members consisted of the following:
 - Joshua Hiatt is a senior in the West Virginia Wesleyan College Department of Physics. Joshua is pursuing a B.S. in Applied Physics with a Math minor. He is involved in the Physics/Engineering Club, Student Partnership for the Advancement of Cosmic Exploration (SPACE), and a member of the Theta Xi fraternity. He is also conducting undergraduate research to build a self-stabilizing platform using an Arduino microcontroller and an Inertial

Measurement Unit (IMU). Joshua plans to attend graduate school in Aerospace Engineering and Space System Engineering.

- Andrew Knotts is a senior in the West Virginia Wesleyan College Department of Physics and is pursuing an Engineering degree. Andrew is involved in the Physics/Engineering Club, Student Partnership for the Advancement of Cosmic Exploration (SPACE), Space Public Outreach Team (SPOT), is an athlete in both Cross Country and Track and Field, and is a member of the Theta Chi fraternity.
 - Edwin Mann is a sophomore in the WVU Department of Computer Engineering. Eddie is pursuing a B.S. in Computer Engineering.
 - Matthew Hergenroeder is a sophomore in the WVU Department of Mechanical and Aerospace Engineering. He is pursuing a B.S. in Mechanical Engineering and a B.S. in Aerospace Engineering.
 - Christopher Sommers is a junior at WVU and is pursuing a B.S. in Mechanical Engineering and a B.S. in Aerospace Engineering. He is a member of the AIAA and the American Society of Mechanical Engineer (ASME) student organizations. Chris is an undergraduate research assistant for the NASA Spray Cooling Project, which researches a promising method for cooling of high power density electronics.
 - Amy Sardone is a senior in the WVU Department of Physics and Astronomy. She has a B.A. in Music from Dallas Baptist University and is currently working towards a B.S. in Physics and Astronomy. Amy is currently conducting research by looking for Fast Radio Bursts (FRBs) in pulsar data from the Green Bank Telescope. Amy will be applying to graduate schools in Physics and Astronomy in 2014.
 - Caitlin Ahrens is a senior in the WVU Department of Physics and Astronomy and Department of Geology. She is pursuing a B.S. in Physics and Astronomy and a B.S. in Geology. Caitlin is currently researching: pulsar glitch analysis at WVU, earthquake hazard assessment at WVU, Martian aeolian geology in collaboration with the United States Geological Survey in Arizona (USGS Arizona), and space dust grain geology in a joint collaboration between WVU and the State University of New York at Geneseo.
 - Joseph Kotula is a sophomore in the WVU Department of Mechanical and Aerospace Engineering. He is a member of the American Society of Civil Engineers and the WVU Snowboarding Club.
 - Ryan Watson is a senior in the WVU Department of Mechanical and Aerospace Engineering.
- Diversity of institutions, faculty, and student participants (gender, underrepresented, underserved).
- WVSGC sponsored students from each of the 12 Academic Affiliates representing diverse academic backgrounds. In FY 2013, students reported 30 distinct academic majors.

- WVSGC exceeded its initial targeted diversity rate of women participation in all our programs. We initially targeted 30% across the board, and due to the fact that the number of female faculty and researchers in STEM fields is much smaller than the number of men in these fields, we were aggressive in engaging female participants. Academic affiliates as well as the management team of WVSGC targeted activities, e-mailed groups, and attended events to inform educators and students of grant opportunities. A result of our efforts are detailed in the following data:
 - a. Research Enhancement programs: 34% female
 - b. Direct recipients of S/F student support: 34% female
 - c. Research Infrastructure: for the first time during the span of the current 5-year grant period, we have more female students engaged in research sponsored by WVSGC than males. As reported by the Science PIs, 14 students participated at this level of research 86% of whom were female.
 - Additionally, both of the only two MSIs in WV are members of the WVSGC. Bluefield State College is represented by Dr. Felica Wooten Williams and WV State University is represented by Dr. Naveed Zaman on the Board of Directors of the NASA WVSGC. In FY 2013, both institutions were active in the Consortium and participated in a number of programs sponsored by WVSGC. Four (4) NASA fellowships were awarded at West Virginia State University and four (4) (including students from the Emerging Leaders Institute) were awarded at Bluefield State College. Also, to conduct undergraduate research under the supervision of Dr. Tesfaye Belay at Bluefield State, four (4) African American students (three female, one male) were awarded summer internships. In FY 2013 we provided \$12,000 to support these summer student internships and a stipend of \$5,000 to Dr. Belay.
- 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.
- Dr. Elizabeth Strong, Near Earth Object Foundation, reported that of the 15 educators which attended the “Elementary Engineering Workshop” over the summer in the follow-up evaluations indicated:
 - 1) One teacher started a STEM club at their school
 - 2) Three teachers wrote grants and received extra funds for classroom engineering projects
 - 3) One first grade teacher is doing a special project “Fairy tale Engineering!”
 - 4) A math teacher is emphasizing the math and engineering behind Appalachian Toys.

- Summer opportunities for secondary students on college campuses with the objective of increased enrollment in STEM disciplines or interest in STEM careers.
 - The 2013 Summer Aviation Camp, which was sponsored by WVSGC, provided exciting hands-on, aviation focused, experience to 42 pre-college students during a three day in-residence camp on the campus of WVU. The camp exposed students to the WVU Engineering campus gave them a chance to interact with current engineering students who served as mentors, allowed them to take part in activities at the Challenger Learning Center in Wheeling, WV, and gave them the opportunity to complete hands-on science projects with an aviation focus. Astronaut Jon McBride inspired the campers with his presentation and participation on the last day of the camp.

- Community Colleges – develop new relationships as well as sustain and strengthen existing institutional relationships with community colleges.
 - Dr. Deb Hemler, Pierpont Community College, reported that to increase participation in the First Lego League (FLL) program they offered free robotics workshops to formal and informal educators through the NASA Independent verification and Validation (IV&V) educator Resource Center (ERC). Over 150 educators participated in the program and for the first time in the WV FLL program history, Bridgemont Community and Technical College, Montgomery, WV, educators were activity involved. In collaboration with Dr. Hemler and NASA IV&V Facility, Bridgemont hosted a Jr. FLL program to provide opportunities for students younger than nine to participate in a statewide event. Although the overall number of students engaged in Jr. FLL increased dramatically, the same number of teams registered with FIRST. At Bridgemont the team mentors were provided an NXT robot and software package to assist the educators in engaging their students in the FLL program. These activities were partially supported by a grant from WVSGC.

- Environmental Science and Global Climate Change – research and activities to better understand Earth's environments.
 - A best described success story is the research work performed by Mr. Colin Komar, NASA WVSGC Graduate Fellow, mentored by Dr. Paul Cassak, Department of Physics and Astronomy at WVU. Mr. Komar has made original contributions to this research, earned national awards, and given invited talks. Mr. Komar's research is on "space weather." He studies magnetic reconnection at the dayside agnetopause as a function of solar wind parameters. This problem addresses a key aspect of space weather, namely how the Earth's magnetosphere reacts to varying stimuli from the Sun. His research used resources at NASA's Community Coordinated Modeling Center (CCMC). In mid-2013, Mr. Komar applied for and received a nationwide award for outstanding research in magnetospheric physics using CCMC

resources. For his prize, he was funded to attend the 2013 Geospace Environment Modeling meeting, give a tutorial lecture about CCMC to graduate students, and gave an invited talk. At the same meeting, he presented his work as a poster and garnered Honorable Mention for the student poster award. Since then, he has been testing models of how and where reconnection occurs at the dayside magnetopause. His is the first systematic attempt to do so using self-consistently generated data from global magnetospheric simulations. He applied for and was given an opportunity to give an oral presentation at the 2013 Fall AGU meeting. This is no small feat - oral presentations at this extremely large meeting are difficult to secure, especially as a student. He is currently writing his results for publication.

Additional current research and activities to better understand Earth's environments are listed below:

- Lyndsay Rankin, a student at Marshall University, faculty mentor Dr. Anne Axel received a Graduate Fellowship to work on a research project entitled: "Using remote sensing to measure the ecological integrity of non-intact tropical dry forests of southern Madagascar."
 - Zane Dennison, a student at Fairmont State University, faculty mentor Dr. Mark Flood, received an Undergraduate Fellowship to work on a research project entitled: "Using Aquatic Organisms to Assess the Effectiveness of Acid Mine Drainage Remediation in the Three Fork Creek Watershed."
 - Dustin Spencer, a student at Fairmont State University, faculty mentor Dr. Mark Flood, received an Undergraduate Fellowship to work on a research project entitled: "Does local Marcellus well drilling impact water quality in streams?"
 - Courtney Swiger, a biology student at Fairmont State University, faculty mentor Dr. Donald Trisel received a NASA WVSGC Fellowship to work on her research project entitled "Testing C3, C4, and CAM Plants Against Global Climate Change Scenarios."
- Enhance the capacity of institutions to support innovative research infrastructure activities to enable early career faculty to focus their research toward NASA priorities.
- WVSGC provided 39 research enhancements awards to faculty at eleven academic affiliates to support innovative research infrastructure activities. In support of their research infrastructure activities, Marshall University reported that nine faculty members (5 female, 4 male) traveled to various locations across the country to collaborate with colleagues and attend and/or present at professional conferences.
 - Dr. Majid Jaridi presented NASA research opportunities to new faculty members at WVU, Benjamin M. Statler College of Engineering. The goal for

the presentation was to introduce early career faculty members to focus their research toward NASA priorities.

IMPROVEMENTS MADE IN THE PAST YEAR

Dr. Majid Jaridi, Director NASA WVSGC, was elected to serve on the Executive Committee Board of the National Council of Space Grant Directors.

We had 100% participation from the Academic Affiliates in using the on-line student application proposal website submitting undergraduate research.

Program Management: We hired a new staff member, Ms. Nancy Vinh, to help with our outreach activities, preparing grant proposals, student contact and general office duties.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

The Consortium is governed by a Board of Directors consisting of one member from each affiliate organization and a few representatives from non-profit organizations and state government agencies. In accordance with its Mission Statement and its by-laws, the Board sets all policies and procedures governing the Consortium operations. Characteristics of our academic and other affiliates of the Consortium are as follow:

- WVU, largest public university in the state, Land Grant, primarily research oriented, represented by Dr. Fred King.
- Marshall University, second largest public university in the state, research oriented, represented by Dr. Charles Somerville.
- Bluefield State College, an HBCU, primarily teaching oriented public university, represented by Dr. Felica Wooten Williams.
- WV State University, an HBCU, Land Grant, primarily teaching oriented public university, represented by Dr. Naveed Zaman.
- Shepherd University, primarily teaching oriented public university, represented by Dr. Reza Mirdamadi.
- WV Wesleyan College, teaching and research oriented private college, represented by Dr. Joseph Wiest.
- Wheeling Jesuit University, teaching and research oriented private university, represented by Ms. Margie Cooke.
- Bethany College, teaching and research oriented private college, represented by Dr. John Burns.
- Fairmont State University, teaching and research oriented public university, represented by Dr. Anthony Gilberti.
- West Liberty University, primarily teaching oriented public college, represented by Dr. Robert Kreisberg.

- WVU Institute of Technology, research and teaching oriented public university, represented by Dr. Paul Steranka.
- Glenville State College, teaching and research oriented public college, represented by Dr. John Peek.
- The Clay Center for Arts and Sciences, non-profit organization with the mission to inspire creativity, learning and wonder through experiences in the arts & sciences, represented by Mr. Lewis Ferguson.
- WV High Technology Consortium Foundation, non-profit organization to promote high-technology and economic growth in the state, represented by Mr. James Estep.
- Polyhedron Learning Media, Inc., a technology development company specializing in creating educational software, audio/video, and print materials, represented by Dr. Jeanne Finstein.
- NASA IV & Facility, represented by Mr. Marcus Fisher, Associate Director.
- NRAO Green Bank Facility, home to the Robert C. Byrd Green Bank Telescope, the largest fully steerable dish in the world, represented by Dr. Karen O'Neil.
- Dr. Anne Cavalier, Educational Consultant.
- TMC Technologies, represented by Mr. L. Wade Linger Jr. TMC Technologies is an Information Technology services company with significant contract experience at both Federal and State government levels.
- TechConnect West Virginia represented by Ms. Anne Barth, Executive Director. TechConnectWV is a statewide economic development organization dedicated to the advancement of science, technology, and the innovation economy in WV, focused on four technology sectors: advanced energy, chemicals and advanced materials, biosciences, and biometrics.
- **The National Space Grant Office requires two annual reports, the Annual Performance Data Report (APD) 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.**