

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

Hawaii Space Grant Consortium
University of Hawai`i at Mānoa

Dr. Luke Flynn
808-956-3138

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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 Hawai'i Space Grant Consortium is a Designated Consortium funded at a level of \$575,000 for fiscal year 2014.

PROGRAM GOALS

The Hawai'i Space Grant Consortium (HSGC) inspires, nurtures, and trains space scientists, space settlers, and aerospace engineers of the future. HSGC's strategy and programs are dynamic and reviewed annually to reflect State as well as NASA program needs and include development and maintenance of the HiSTEM Pipelines of activities (undergraduate/graduate opportunities supported by pre-college activities in the areas of space science, engineering, and remote sensing), enhancing undergraduate education through research (fellowships, traineeships, and internships that **must** have a NASA focus) and course curricula, improving research infrastructure (Hawai'i Space Flight Laboratory (HSFL)), training pre-service and in-service teachers (Future Flight Hawai'i and Families Exploring Science Together (FESTival) Night Programs), and educating the public about new NASA discoveries (Windward Community College Aerospace Lab, Planetary Science Research Discoveries and Astronaut Days of Discovery events), helping to strengthen the State economy (HSFL, extensive support and continued efforts of Hawai'i's initiatives to promote global awareness and collaboration in robotics).

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

HiakaSat Delivery - Outcome 1: In November 2014, HiakaSat was completed, shipped to Kirtland AFB for payload integration, and tested as part of the integrated payload stack for the ORS-4 Mission. ORS-4 is scheduled to launch in October 2015. HiakaSat passed NASA-level thermal vacuum and vibration testing, and passed a Pre-Ship Readiness Review administered by the AF ORS Office. The HiakaSat project included over 60 students that helped to design, build, and test HiakaSat according to NASA standards. The HSFL I&T Facility represents a significant University investment and many small businesses are now approaching the University to perform aerospace testing at the facility. Students continue to benefit by helping to set-up and perform tests.

Brendan Hermalyn – Outcome 2: Dr. Brendan Hermalyn is the ultimate Space Gant poster child when it comes to retaining students in STEM. Dr. Hermalyn reports that he received an undergraduate fellowship from Connecticut Space Grant for aerospace related research. He later went to Brown University and received a Rhode Island Space Grant fellowship that allowed him to work on a NASA mission. Finally, as a post-doctoral researcher and young faculty member with the University of Hawai'i Institute for Astronomy and the Hawai'i Space Flight Laboratory, Brendan was able to win a NASA EPSCoR CAN award to further his research. Dr. Hermalyn is now on a leave of absence from HSFL, but is working on a new series of space cameras for SkyBox Imaging, which is now a division of Google. Through NASA Ames, Dr. Hermalyn has been a team member on many NASA missions to the Moon.

America View and HSGC – Outcome 3: With limited resources, HSGC continues to leverage opportunities that will allow us to inspire the next generation of NASA explorers. America View is a United States Geological Survey program to advance the use of Landsat remote sensing data in the classroom. HSGC's Amber Imai is partially funded by America View to share hands-on Landsat and spectral data studies with middle school students at HSGC's Family Science Nights. The partnership allows us to stretch America View and Space Grant funding further on a collaborative STEM effort.

PROGRAM ACCOMPLISHMENTS

Outcome 1: *Hawai'i Space Flight Lab (HSFL)* – The HSFL is an HSGC Research Infrastructure program that is leveraging State, Federal (including NASA), and corporate partners to provide student and workforce training opportunities to design, build, launch, and operate small spacecraft. The State of Hawai'i signed a Space Act Agreement NASA Ames, that was renewed in 2013, to help with HawaiiSat-1. HawaiiSat-1 has been redesigned to HiakaSat, which is a 55-kg microsatellite that has an infrared hyperspectral imager developed by University of Hawai'i faculty and will be launched to a 500-km orbit from Hawai'i in Fall 2015 on the Operationally Responsive Space-4 Mission. HiakaSat will also carry a technology payload developed by Honolulu Community College. HiakaSat has now been delivered and is awaiting launch day. HSFL is also working on two low-cost lunar mission concepts with NASA Ames and international partners. The HSFL I&T Facility is also being used by small businesses for aerospace testing of subsystems, instruments, and components. Dr. Trevor Sorensen, Mr. Eric Pilger, and Mr. Miguel Nunes

have spun-off a private company based on the mission control software that was developed for the HiakaSat satellite.

Outcome 2: IMUA Project – HSGC is especially pleased to report that a group of HSGC Associate Directors won a NASA grant to work towards building a CubeSat at the UH Community Colleges with 1st and 2nd year students. Drs. Joseph Ciotti (Windward CC), Jacob Hudson (Windward CC), Georgeanne Purvinis (Kauai CC), Gregory Witteman (Honolulu CC), and Herve Collin (Kapiolani CC) with students at respective institutions are all partners to launch a RockSat-X suborbital payload in the summer 2015. Subsystems, instruments as well as engineering reviews are entirely assembled and managed at the Community Colleges. The IMUA effort represents an important first step, not only in the small sat pipeline of student education projects, but will eventually serve as a hands-on program that will provide circuit boards, subsystems, instruments, 3-D printing prototypes, and ground station support for HSFL Missions. For example, Kauai CC students and staff are building a neutron detector for an HSFL 3-U CubeSat mission that is part of NASA's ELaNa Program.

Outcome 3: HSGC continues to offer community outreach programs. Many of these programs have strong NASA content but have been adopted by other private sponsors. Mr. Arthur Kimura, Director of Future Flight Hawai'i, has written numerous education proposals to the Thirty Meter Telescope education fund in order to supplement HSGC funding. Windward CC is constantly expanding the offerings of its Aerospace Lab that includes flight simulators, a planetarium, radio telescopes, and soon, the HSFL education and public outreach center to track HSFL missions. Windward CC's Dr. Jake Hudson is also helping with the Kauai CC rocketry program. *Astronaut Days of Discovery* – These days celebrate Hawai'i's astronauts and remain overwhelmingly popular. They showcase NASA and STEM presentations and hands-on activities. HSGC coordinates the events but Hawaiian Electric Company, the Chatlos Foundation and American Savings Bank are major sponsors that help to donate funds and volunteer to make the events successful. *Imiloa Astronomy Center* – The Imiloa Astronomy Center now features a part of the Carl Sagan Planetary Walk that begins in Ithaca, NY. The Imiloa Astronomy Center sculpture, Kamailehope, represents the position of the closest star to our solar system, Alpha Centauri, on the scale of the Sagan Planetary Walk.

PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE MEASURES

- **Diversity:** With the exception of the University of Hawai'i at Manoa campus, all of our HSGC affiliates are Minority Serving Institutions. HSGC has made significant strides to include underrepresented students in our Fellowship and Traineeship programs. On average over the last 5 years, we have maintained that 50% of our fellowship awards are given to underrepresented students. We have also attracted a significant number of women applicants and awardees to our fellowship and traineeship programs. We strive to continue this trend and are greatly aided by our affiliates who share the HSGC vision of a diverse NASA and aerospace workforce.

- Minority-Serving Institution Collaborations:** UH Hilo, UH Maui College as well as all of the UH System Community Colleges are minority serving institutions. The HSGC maintains strong ties with its affiliates through dedicated associate directors. Windward, Honolulu, Kapiʻolani, Kauaʻi, and UH Maui College receive HSGC support for CanSat programs. Windward CC is also supported for the Aerospace Lab. Kauaʻi CC has installed UHF/VHF and S-band ground stations for the HSFL and new research experiments. Honolulu CC has a new X-band receiving station that can be used for HSFL missions. Five UH minority serving colleges (Windward, Honolulu, Kapiʻolani, Kauaʻi, Leeward, and UH Maui College) want to build CubeSats and a subset of these campuses are now taking an active role in the first suborbital launch of the two-year IMUA Project.
- NASA Education Priorities:** The HSGC has partnered with the State of Hawaiʻi and others to host hands-on robotics programs (FIRST, Botball, MicroRobots) at the elementary and intermediate school levels. HSGC has a rich history of teacher training using hands-on NASA-related science content through Families Experiencing Science Together (FESTival Nights) that include a minimum of 8 science teachers and 100 student-parent teams in an evening hands-on workshop, Future Flight Hawaiʻi summer program that is a weekend long activity using related hands-on activities to replicate science missions to other planets, and the two Astronaut Days of Discovery where teachers help to run up to 20 hands-on activities for 600 students and parents during a day-long science fest. Five UH minority serving colleges (Windward, Honolulu, Kapiʻolani, Kauaʻi, Leeward, and UH Maui College) want to build CubeSats to encourage underrepresented students to pursue STEM careers. Honolulu and Kauaʻi CC are working to convert their physical electronics labs to be able to build satellite circuit boards. This training is important for future development of a small sat industry in Hawaiʻi. HSGC encourages the career development of young faculty by providing mini-grants and travel awards as appropriate in order to further NASA research interests. HSFL is working with NASA Ames to develop small (~100 kg) lunar mission concepts for less than \$50M each using the rocket that will be used in the ORS-4 Mission.

IMPROVEMENTS MADE IN THE PAST YEAR

Within the \$575,000 budget, HSGC has tried to maintain as many programs as possible. We continue to focus our efforts on our fellowship program and have used fellowship support to complete our first satellite – HiakaSat – which will launch in 2015 on the ORS-4 Mission. With limited funds, we have to send less students to the more expensive NASA internships.

HSFL and IMUA project –The ORS-4 launch will take place in Fall 2015. HSFL successfully delivered the 55-kg HiakaSat satellite to the Operationally Responsive Space Office in November 2014. HiakaSat was built by over 60 students and staff that were partially supported on NASA fellowships and internships. Honolulu CC provided a technology payload for HiakaSat that will take pictures of the release of the HiakaSat satellite from the launch vehicle during the ORS-4 Mission. Installation of an S-band ground station at Kauaʻi CC has continued and will be completed in 2015. All of these

assets are also available to support a small sat economy in Hawaii. A subset of HSGC Community College affiliates embarked on their own 2-year IMUA program to build a CubeSat entirely with 1st and 2nd year students. Project IMUA will launch its first suborbital payload in summer 2015 on RockSat-X.

Percentage of Underrepresented Students Served – HSGC maintains support for underrepresented students who have received an average of 50% of the total awards given in the past 5 years.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

UNIVERSITY OF HAWAII AT MANOA – 4-year university with graduate programs – Director Dr. Luke Flynn; Program Coordinator Ms. Marcia Rei Sistros; Headquarters of HSGC and HSFL; majority of graduate and undergraduate fellows, interns, and trainees perform research in CubeSat and small satellite design, astronomy, planetary science, geology, engineering, marine science, remote sensing, and computer science.

UNIVERSITY OF HAWAII AT HILO – 4-year university with graduate programs – Associate Director Dr. Ken Hon; undergraduate fellows and trainees have focused research on the strong astronomy, geology, and remote sensing programs. UH-Hilo along with American Savings Bank hosts the Astronaut Ellison Onizuka Day public science program annually in January.

UNIVERSITY OF HAWAII MAUI COLLEGE – 4-year university with graduate programs – Associate Director Dr. Jung Park; undergraduate fellows and trainees have focused research in astronomy, optics, and STEM. Associate Director and students attended Rock-On Workshop in 2014. The Akamai Internship Program gives students opportunities for internships through the Center for Adaptive Optics.

HAWAII COMMUNITY COLLEGE – Associate degree granting community college – Associate Director Dr. Joseph Wilcox; undergraduate trainees focus on STEM and astronomy.

HONOLULU COMMUNITY COLLEGE – Associate degree granting community college – Associate Director Dr. Gregory Wittman; undergraduate fellows and trainees have focused research on CanSat design. Dr. Wittman and students built a technology payload for the HiakaSat spacecraft and are IMUA project members.

KAPĪOLANI COMMUNITY COLLEGE – Associate degree granting community college – Associate Director Dr. Herve Collin; undergraduate fellows and trainees have focused research on CanSat design and competitions, and engineering. Kapi`olani CC is an IMUA project member and also receives Federal funding to attract underrepresented students to STEM careers and HSGC programs.

KAUA`I COMMUNITY COLLEGE – Associate degree granting community college – Associate Director Dr. Georgeanne Purvinis; undergraduate fellows, interns, and trainees have focused research on STEM including satellite telemetry with a new ground station, rocketry, CanSat, meteorology, optics, and the IMUA project.

LEEWARD COMMUNITY COLLEGE – Associate degree granting community college – Associate Director Mr. Nikolaj Nordkvist (left during 2014 to accept a position outside of academia), Mr. Roger Kwok serves as interim Associate Director; undergraduate fellows and trainees have focused research on engineering and astronomy. Leeward CC assists

with the HSGC summer Future Flight Hawai'i program and Astronaut Lacy Veach Day which is a festival of science activities held on O'ahu in October.

WINDWARD COMMUNITY COLLEGE – Associate degree granting community college – Associate Director Dr. Joseph Ciotti; Rocketry Coordinator/CanSat Liaison Mr. Jacob Hudson; undergraduate fellows and trainees have focused research in astronomy, CanSat design and competition, and rocketry. Windward CC is the IMUA project lead. The IMUA project is a Hawaii community college effort to build CubeSats. Windward CC hosts various outreach activities from the Hokulani Imaginarium and through the Aerospace Lab, serves as outreach for HSFL, and offers an aerospace certificate.

UNIVERSITY OF GUAM – 4-year university with graduate programs – Associate Director Dr. Mark Lander, undergraduate focus on STEM.

HAWAIIAN ELECTRIC COMPANY – Industrial affiliate – Industry Affiliate Mrs. Dora Nakafuji; HECO supports Astronaut Lacy VeachDay and other HSGC programs both with funding and volunteers.

STRATEGIC THEORIES UNLIMITED, LLC – Industrial affiliate – Liaison/Industry Affiliate Mr. Stewart Burley, STU LLC; assists recruitment from Kaua'i CC to participate in HSGC's undergraduate programs and local internship opportunities on Kaua'i, and provides consulting expertise, networking opportunities with other industry partners and support on HSFL efforts with the Pacific Missile Range Facility, Lihue, Kaua'i.