

FY 2019 Year 5 Extension Annual Performance Document

Arizona Space Grant Consortium

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A. 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 Arizona Space Grant Consortium is a Designated Consortium funded at a level of \$760,000 for fiscal year 2019.

B. PROGRAM GOALS:

The Arizona Space Grant Consortium (AZSGC) Mission, Goals, Vision, and SMART Objectives were last defined and approved by the State Management team (managers from all member universities and affiliate partners) on December 20th, 2019, and are reviewed and re-approved annually at AZSGC's Statewide Meetings. The AZSGC mission is to expand opportunities for Americans to learn about and participate in NASA's programs by supporting and enhancing science and engineering education, research, and outreach and by delivering high-quality public education programs. Our goal is to integrate research with education to help build a diverse, scientifically literate citizenry and a well-prepared science, technology, and engineering workforce. Our vision is to extend the reach of NASA by expanding our universities' capacity to conduct research and STEM engagement in a way that educates the next generation of scientists and engineers in direct partnership with industry and NASA. AZSGC evaluates programs' success via qualitative and quantitative methods and longitudinal tracking of "significant" direct-funded students to ensure continuous process improvement. AZSGC's program area goals are:

a) NASA Internships, Fellowships, and Scholarships (NIFS):

- Help build a diverse and well-prepared STEM workforce by funding "significant" awards for (≥ 88.5) Undergraduate (mentored) Research and Graduate (outreach) Scholars. Awardees will learn about, participate in, and share with others the broad-based science, engineering, and education research priorities of NASA's Mission Directorates. To ensure topical diversity of research projects, placements will be made in a variety of (> 30) NASA-related disciplines.
- Incorporate students into Arizona's distinguished space science/engineering research enterprises on campus, with industry, at Federal research facilities, and at NASA Centers (> 3

placements in industry/NASA Centers). Optimize opportunities for professional growth through generating (>10) publications and/or presentations at professional meetings.

- Use NIFS programs to expand representation among active scientists and engineers of our nation's diverse population (30% diversity of awardees, 45% female awardees). 100% of significant awardees will be tracked to next steps after graduation, >90% of awardees will complete college degree programs and >85% of program graduates will pursue advanced degrees in NASA-related STEM fields and/or enter the nation's STEM workforce.

b) Higher Education (HE):

- Support faculty, student, and community college initiatives to develop (≥ 6) interdisciplinary courses/curriculum, and/or training for pre- and in-service teachers. Support activities designed to enhance, complement, and grow the workforce development potential of AZSGC programs.
- Involve ≥ 9 MSIs in HE activities including the Statewide Undergraduate Research Scholar Symposium (an important educational and professional growth experience).
- Recruit and support a diverse group of participants (41% diversity of participants, 45% female participation), and sponsor (>8) group educational activities for NIFS students and others to complement learning, foster a sense of community, and promote networking and professional growth.

c) Research Infrastructure (RI):

- Support (>8) multi-disciplinary flight and (≥ 2) non-flight programs with space science/engineering-focused research and design. AZSGC uses these programs to provide associated hands-on opportunities to apply classroom knowledge to real-world problems that promote "cooperative programs among community colleges, universities, aerospace industry and Federal, state and local governments" as articulated in the National SG objectives.
- Build NASA Center and industry partnerships with ≥ 2 NASA challenges and ≥ 1 industry program.
- Provide students from (≥ 3) universities and (≥ 6) community colleges in Arizona with a variety of team research, engineering, and design programs. Provide opportunities to work as team members, be held to industry standards for deliverables, complete tasks on schedule, and communicate about technical work to professionals, peers, and the public through oral and written presentations. Students work side-by-side with science and engineering faculty and researchers in industry.
- Use RI programs to expand participation and representation among future and active scientists and engineers (35% diversity of participants, 45% female participation).

d) Pre-College (PC):

- Support initiatives that align with AZ and National Standards to improve STEM education, encourage underrepresented groups into STEM, and encourage professionals and students to undertake public and school outreach.
- Deliver NASA-related STEM and leading-edge technology to Arizona's remote, underrepresented, under-served, and struggling schools.

e) Informal Education (IE):

- Engage, interest, and educate the general public in NASA topics through outreach programs by training ≥ 4 AZSGC Graduate and Undergraduate Scholars to deliver IE programs.
- Involve NIFS students in public outreach through formal and informal educational channels at a variety of locations/venue types (>4).

C. PROGRAM/PROJECT BENEFIT TO PROGRAM AREAS:

Sarah Rogers, an Arizona State University (ASU) Aerospace Engineering major, received two NASA Space Grant research scholarships during her undergraduate career. Now a graduate student, Sarah is the Project Leader for the “Phoenix” CubeSat Urban Heat Island (UHI) project. The mission of this project, which started under an AZSGC USIP grant in 2016, was to design and build a 3U CubeSat from scratch that would collect climate, UHI, and imaging data from approximately 8 large U.S. urban cities. Once sent back to ASU’s ground station, this data would be used to study the cause and effect of UHIs to help research more sustainable urban growth plans for future generations. On Saturday, November 2nd, 2019, the Phoenix was successfully launched from the Wallops Flight Facility to the International Space Station (ISS). The Phoenix will be deployed from the ISS in February 2020. This project has been highly successful and is unique in that the mission has been primarily student-driven. Sarah leads a team of more than 90 ASU students and three higher education faculty mentors. Sarah will attend the 30th Anniversary Space Grant event at the Rayburn House on Capitol Hill on February 25th, 2020 to present preliminary results of this mission on behalf of AZSGC and her team.

Phoenix College (PC) is an exemplary participant of the AZSGC ASCEND balloon-satellite launch program, and ASCEND scholars are going beyond the program and progressing to NASA challenges, internships, and soon Capitol Hill. Maxx Mudd’s successful completion of the NCAS workshop at NASA JPL this February 2020 marks PC’s seventh ASCEND student to complete the program. NCAS directors and the community have taken notice, and two local Maricopa newspapers have written articles about PC ASCEND students’ successes. In addition to these accomplishments, the PC ASCEND club has elected two female presidents for the past two years. Eunice Lopez, a Software Engineering major, and Jessica Frantz, a Mechanical Engineering major, led their teams as they’ve developed a real-time communication system capable of transmitting video on the 5 GHz bandwidth. When used in high-altitude-ballooning applications, this system offers students the ability to monitor their atmospheric experiments in real-time. PC also developed an electrical-mechanical system capable of stabilizing video on the yaw axis. Eunice and Jessica helped their teams successfully pioneer these new, complex systems which will continue to be flown in future ASCEND flights. Both Eunice and Jessica will also present these applications at the 30th Anniversary Space Grant Event on Capitol Hill and we are proud to have them represent AZSGC.

D. PROGRAM ACCOMPLISHMENTS:

a) NASA Internships, Fellowships, and Scholarships (NIFS):

In FY 2019-20, AZSGC sponsored programs designed to address NIFS goals with accomplishments measured against SMART objectives and awarded 111 Undergraduate Scholars, 9 Graduate Scholars, and 27 community college ASCEND balloon-sat significant student awards (ASCEND students reported in RI). Of 147 total NIFS awardees, 60 (40.8%) are underrepresented minorities, 77 (52.4%) are female, 3 have disabilities and 4 are veterans. NIFS and RI ASCEND scholars report 46 distinct academic majors. AZSGC Graduate Scholars

designed and delivered outreach programs to a variety of user groups, and 39 Arizona State University Undergrad Scholars are contributing 20 or more hours to STEM outreach in local schools and other venues through PC and IE components. Together, NIFS scholars conducted outreach with 26 non-affiliate partners. Undergraduate Scholars from the University of Arizona (UA), Arizona State University (ASU), Northern Arizona University (NAU), and Embry-Riddle Aeronautical University (ERAU) work with 76 unique researchers from Arizona's universities, public, and private research sectors, in hands-on professional work experiences across 48 NASA-related topical disciplines and 9 industry or government placements. In FY 2019-20 to date, 3 AZSGC authors published 2 articles, 10 authors have papers in-press, 7 authors presented their research at conferences, and 3 authors self-submitted and presented papers with a review process. All Undergraduate and ASCEND scholars will present at the Statewide Symposium in April 2020, and Graduate Scholars will make formal outreach program review presentations. Tracking records have been generated for all program awardees and will be maintained and updated. Of 1,585 total AZSGC 2006-2019 NIFS significant award recipients: 1,376 (86.8%) have completed degree programs. Of those graduates, 75 are seeking STEM work and are still-to-be tracked to their next steps. However, the remaining 1,301 have taken next steps, and of these, 1,220 (93.8%) are employed in STEM fields or are pursuing additional, advanced STEM degrees. We met or exceeded all NIFS program area goals and SMART objectives.

b) Higher Education Projects (HE):

AZSGC sponsored 11 higher education programs in FY 2019-20 to date, with 275 student participants. Programs address the HE goals above, and accomplishments are measured against SMART objectives. 82 participants (30%) are from underrepresented groups and 154 (56%) are female. 6 Minority Serving Institutions (MSIs) - Central Arizona College (CAC), Diné tribal College, Glendale Community College (GCC), Phoenix College (PC), Pima Community College Northwest Campus (PCC NW), and Tohono O'odham tribal Community College (TOCC), participate in FY 2019-20 programs, in addition to the UA (HSI) and ASU (Emerging HSI).

Programs include **1) The AZSGC Statewide Symposium**. In April 2019, the 28th Annual AZ/NASA Statewide Undergraduate Research Scholars Symposium featured 160 student presentations relevant to all NASA Mission Directorates. Similar numbers are expected to be reported in April 2020. **2) The UA Students for the Exploration and Development of Space (SEDS) community outreach and educational enhancement activities.** **3) Two revised NASA STEM-focused UA Planetary Geosciences graduate field courses.** **4-6) UA, ASU, and NAU education, networking and promotion activities** for Space Grant undergraduate scholars including interactive lunch sessions with expert speakers from university and industry, professional skill-building workshops (how to write an abstract, build and deliver PowerPoint presentations, etc.), and an ASU-sponsored professional poster design workshop. **7) STEM lab course enhancements at TOCC**, including 1 revised STEM courses to-date. **8) ASU's Alumni Night**, where past and present Space Grant scholars meet, network, provide and receive STEM career advice, listen to a keynote talk from an alumnus/alumna in industry or academia, and inspire each other. **9) The NAU American Indian Science and Engineering (AISES) and Hispanic Engineering clubs** including support for participation in the First Nation's Launch Program. **10) NAU sponsorship of an undergraduate Astronomy Club and the Society of Women in Space Exploration.** And **11) NAU's Northern Arizona Planetary Science Alliance (NAPSA)** undergraduate poster session. In addition to these programs, 3 HE courses have been revised

directly related to the ASCEND (RI) balloon-satellite program, for a total of 6 revised HE courses. 5 non-AZSGC affiliates collaborated on HE programs to extend reach and impact.

Another 4 HE programs will occur this spring 2020, including the **1) NAU Research and Design Day** where undergraduate students showcase and present the results of their research to the public. **2) ASU's Space Grant Poster Session** showcases AZSGC and ASCEND scholars' research to the campus community via professional posters and hands-on science demonstrations. **3) UA's Teachers in Industry** program, which provides long-term sustained professional development training to educators. And **4) the Space Camp at Biosphere 2 (SCB2)** program, where undergraduates from AZSGC and Kyoto University work together as a space flight crew for one week while performing various research activities inside of Biosphere 2. AZSGC met or exceeded all HE program area goals and SMART objectives except for our diversity goal of 41% (30%). With several pending programs this academic year we strive to meet this goal.

c) Research Infrastructure Projects (RI):

AZSGC sponsored 8 research infrastructure programs in FY 2019-20 to date, with 370 student participants and 6 flight and 2 non-flight programs. All programs address the RI goals above, with accomplishments measured against SMART objectives. Participants included 92 (25%) underrepresented students and 82 (22%) women. Of those participants, 27 students are directly funded in significant faculty-mentored RI experiences; 17 (63%) are from under-represented ethnic/racial groups, and 8 (30%) are women.

The 6 student team flight projects are **1) The Statewide balloon-satellite program, ASCEND**. **2) ASU's Sun Devil Rocketry** chemical propulsion and flight vehicle development program. **3) ASU's Sun Devil Sat Lab** Phoenix CubeSat project. **4) The ASU HASP** payload launch team. **5) ERAU's EagleSat CubeSat** development program. And **6) ERAU's Eagle Space Flight Team**, the first undergraduate team in the country to construct and fly a rocket to the legal limits of space. All flight programs are conducted in partnership with NASA centers and/or aerospace industry. Nine college and university teams (including 6 HSIs, 2 TCUs, and 1 emerging HSI) participate in ASCEND, with opportunities to experience the full design-build-fly-operate-analyze cycle of space missions. AZSGC's two non-flight programs include **7) ASU's Robotics Team Projects** and **8) NAU Space Grant scholars travel grants for competitively selected National Undergraduate Research Observatory (NURO)** astronomy students to travel to Arizona with mentors and observe on a 31-inch telescope owned by Lowell Observatory. RI programs collaborated with 28 non-AZSGC affiliates to extend reach and increase impact of our programs.

All programs met the AZSGC RI goal of providing authentic, hands-on student experiences rooted in NASA-related topics and incorporate real-life problem solving with a strong workforce development focus. However, we did not meet our RI goals and SMART objectives for gender and diversity of direct participants in RI. Yet, we note that AZSGC greatly exceeds our diversity goal for directly funded RI participants at 63%.

d) Precollege Programs (PC):

AZSGC sponsored or contributed to 7 PC programs in FY 2019-20 to date that cumulatively served 147 Arizona formal and informal educators and 2,730 pre-college students. Activities

were conducted with partners (including museums and science centers) to leverage funding and extend reach. Programs address the PC goals above, and accomplishments are measured against SMART objectives. PC programs are strategically directed to underrepresented/underserved groups and areas of greatest need. Programs include **1)** UA's support of AIAA Kids Club, which integrates NASA material in a Saturday hands-on club to excite, educate, and build skills to pursue NASA STEM in school. **2)** ASU's Undergraduate Scholars conducted a variety of PC outreach events, including the DISCOVERoom at Kyree de la Colina, the Hermanas STEM Conference, and physics presentations to Desert Mountain High School. **3)** NAU's Lowell Observatory Native American Astronomy Outreach program to deliver NASA space science content by partnering with 7 of the Kayenta Unified School District's 4-7th grade teachers for 3 years to work with reservation schools. **4)** NAU's American Indian Mobile Education Resource (AIMER) traveling science classroom. Educators have worked directly with 1,940 elementary to high school students to date and conducted 20 school visits (lasting 1-5 days) to 7 unique reservation schools and communities. AIMER also conducted outreach at the NAU Science and Engineering Day, the Mercury transit at NAU, and star parties at Snow Bowl, Flagstaff, and Navajo Bridge. UA and ASU Graduate Scholars also developed and delivered programs to schools with large underrepresented populations including **5)** UA graduate scholar, Erin Maier, who is developing an instrumentation curriculum for local astronomy education programs. **6)** UA graduate scholar, Charles Parrish, is working on a virtual reality curriculum for Pre-College STEM education. And **7)** ASU graduate scholar, Ashley Curiel, is preparing two high schools, over 70 students, and 3 STEM teachers, to participate in the ASCEND balloon satellite launch program. One additional PC program will occur this spring 2020. **1)** The NAU's sponsorship of the Nizhoni Academy, a four-week summer residential STEM program at NAU for Native high schoolers. PC programs collaborated with 16 non-AZSGC affiliates to extend reach and increase impact of our programs.

All programs focus on NASA-relevant research and skill-building topics, incorporate NASA data, curricular materials and/or expertise, and align with state common core STEM standards. Each unique program is evaluated using qualitative and quantitative methods, and NASA funds are leveraged with the support, training, and outreach of Space Grant scholars and fellows. These programs and activities contributed directly to PC goals and SMART objectives; all goals were met.

e) Informal Education Projects (IE):

AZSGC sponsored or contributed to 11 IE programs in FY 2019-20 to date. Activities were conducted with 47(non-affiliate) partnering organizations to leverage resources and extend reach. These programs build strategic partnerships with formal and informal STEM education providers to share NASA research. Programs include **1)** UA graduate scholar, Dawson Fairbanks, creating educational videos for display at a science center on Career Paths in Environmental Sustainability. **2)** UA graduate scholar, Allison McGraw, creating a bilingual planetarium show for the general public to be displayed at (AZSGC affiliate) Flandrau Planetarium and Science Center titled "Meteorites: Mysterious Missing Links." **3)** UA graduate scholar, Trevor McKellar, creating a Drought Monitoring Guidebook for land managers and researchers. **4)** UA graduate scholar, Diana Zamora-Reyes, creating Story Maps to Raise Public Awareness about Flooding in Arizona for the Spanish-speaking population in Arizona. **5)** UA Science Speakers, a program with 25 speakers offering 52 different talk topics, provides renowned experts at no charge to

schools and community organizations. **6)** ASU graduate scholar, Derek Goss, developed a college-level curriculum for a Metal Additive Manufacturing Industry course. **7)** ASU's Undergraduate Scholar Informal Education Outreach fosters leadership in a variety of community STEM educational events, including Earth and Space Exploration Day, the ASU Earth and Space Open House, and the ASU campus-wide Open Door event. These are just some of the large public events these scholars volunteer at to inform community members of leading-edge NASA research and development. **8-9)** ASU's Sun Devil Rocketry team and Underwater Robotics (part of the Robotics team) both conducted outreach at the ASU Open Door, Homecoming, and Earth and Space Exploration Day events. **10)** ASU's Sun Devil Sat Lab team conducted K-12 STEM outreach through a fun, hands-on rocket launch program for students. And **11)** NAU supported the Flagstaff Festival of Science, a large, 10-day community event and the longest-running annual science festival in the country. One additional IE program will occur this spring 2020. **1)** NAU's sponsorship of two Middle School Science Clubs. These IE activities contribute directly to AZ IE goals and all SMART objectives were met and often exceeded.

E. MILESTONES:

All but one AZSGC milestone has been met in a timely manner with little variability from our proposed timeline. AZSGC milestones successfully completed thus far encompass a wide variety of tasks including the management, awarding, implementation, and tracking of all programs mentioned above, in addition to administrative tasks including hiring, reporting, proposal writing, travel to Space Grant meetings, and more. The AZSGC milestone that has not been met is the NAU Women in Physics travel awards that should have been reviewed/distributed in January 2020. NAU Associate Director, Nadine Barlow, did not receive the Women in Physics Conference notification until two days before the event. Thus, all travel plans and attendees had already been arranged. This does not present a significant deviation from our proposed milestones (\$1,600 NASA funds from the base + augmentation budget were to be awarded to this program). Funds will be used to support the club in other ways.

F. PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE GOALS:

- **Diversity:** AZSGC involves Arizona's four, 4-year research universities as members. The UA is a HSI and ASU is an emerging HSI. NAU ranks near the top of non-tribal institutions across the country in graduating Native American students from more than 125 distinct tribes. Members work with 27 affiliate partners including 6 MSI/HSI/TCU community colleges, and federal research organizations, private industry, and for- and not-for-profit research enterprises. The state management team has 12 active members (58.3% women, 25% underrepresented) representing 16 diverse NASA/educational disciplines. Of our NIFS, HI, and RI significant awardees, we exceeded our gender diversity goal (52.4%) and met or exceeded our ethnic-racial diversity goal (41%). Most RI, PC, and IE programs serve schools/groups with large percentages of underrepresented in STEM/underserved participants. Across the state, 145 unique formal educators, 2 informal educators, and 6 museums, science centers, and educational centers were affiliated with our PC programs.
- **Minority Serving Institution Collaborations:** AZSGC includes 6 MSI/HSI/TCU community college affiliates: CAC, Diné (Tribal), GCC, PC, PCC NW, and TOCC (Tribal); 1 University HSI (UA, lead institution); and 1 emerging HSI (ASU).

- **Office of Education Annual Performance Indicators (APIs):**

- API 3.3.3: STEM-19-1: 104
- API 3.3.5: STEM-19-5: 17

G. IMPROVEMENTS MADE IN THE PAST YEAR:

Each year, AZSGC managers and partners work to improve programs and evolve systems for conducting daily business more efficiently and effectively. Susan Brew (UA, lead institution) spent significant time updating alumni records and tracking databases during FY 2019-20. Brew created a much-needed longitudinal tracking database for all 2006-forward community college scholars in the AZSGC lead institution's FileMaker Pro 18 Advanced longitudinal tracking database. The database is complete with 'quick counts' to help track next steps, demographics, etc. without double-counting any repeat scholarship winners. NAU and ASU continued their targeted recruiting efforts in order to meet NIFS and HE gender and diversity goals. NAU's efforts included sharing resources/collaborating with several minority-serving STEM scholars programs, resulting in the NAU AISES club connecting with NAU Space Grant Director, Nadine Barlow, and NAU (native) faculty member, Carson Pete, to participate in the First Nations High Powered Rocket Launch with Wisconsin Space Grant Consortium. The team has been invited to participate in the event once again this spring 2020. ASU managing staff executed a recruitment plan beginning spring 2019 that concentrated more effort on the recruitment of underrepresented students into the program - an area that showed deficiency in recent years. In one year, the number of underrepresented students increased from 26% to 45% for FY 2019-20. Additional efforts are being made to help bridge community college students into the four-year university environment. ASCEND students from local community colleges are now being included in the ASU Space Grant poster session as presenters.

H. CURRENT AND PROJECTED CHALLENGES:

AZSGC experienced several staff changes before the start of this academic year. Though typical for our Community College (CC) points of contact, AZSGC managerial staff saw a change as well. Long-time NAU Sr. Program Coordinator, Kathleen Stigmon, retired in August 2019 and new coordinator, Paloma Davidson, joined the NAU team in January 2020. ASU Space Grant's Financial Specialist left and was replaced by Office Assistant, Alexa Drew (a former Space Grant undergraduate research scholar). Other changes included the ASCEND faculty mentor at Diné Tribal College suddenly leaving for another position and several new staff in our University and CC affiliate's grant management departments. This continues to present significant challenges for knowledge transfer, training, and reporting.

I. PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION:

MEMBERS (4): Member universities maintain program offices, staff, local steering committees, and sponsor/manage Space Grant programs. Managers from each member university form the AZSGC State Management team.

University of Arizona (UA) [Lead]: Public Ph.D.-granting Land Grant, R1 Research University and HSI. The UA provides AZSGC leadership, the Director, Manager, and website support. The UA distributes funding to members and affiliates, gathers, composes, and submits OEPM and other reporting, leads statewide proposals, interacts with NASA, helps develop and implement policy, and provides a significant portion of AZSGC cost-sharing. The UA sponsors programs in

all activity areas; NIFS - Undergraduate (mentored research) Scholarships, and NASA outreach-based Graduate Scholarships; HE - Hosts the AZSGC Undergraduate Scholar Research Symposium alternate years, supports the UA planetary geology graduate field courses, advises/supports UA Students for the Exploration and Development of Space (SEDS), funds Teachers in Industry and Tohono O’odham Tribal College STEM initiatives, NIFS educational enhancement experiences, and supports the Space Camp at Biosphere 2; RI - Leads the ASCEND statewide balloon-sat program; PC - Graduate Scholar-led outreach to local schools, AIAA/Space Grant Kids’ Club; and IE – Various effort to maintain/sustain partnerships with Museums/Science Centers and outreach to local K-12 schools through the Science Speakers program.

Arizona State University (ASU): Public Ph.D.-granting R1 Research University and emerging HSI. ASU provides an Associate Director, Coordinator, and Assistant for AZSGC. ASU sponsors programs in all areas; NIFS - Undergraduate (mentored research) Scholarships, and NASA outreach-based Graduate Scholarships; HE – Hosts the AZSGC Undergraduate Research Scholar Symposium alternate years, Alumni Night, supplemental educational experiences for NIFS students, and campus poster session/recruiting; RI – team engineering programs including balloon-sats, robotics, rocketry and satellite development; PC and IE – NIFS and graduate scholar-led outreach to a variety of PC and IE audiences on and off the ASU campus.

Northern Arizona University (NAU): Public Ph.D.-granting R2 Research University. NAU provides an Associate Director and Coordinator for AZSGC. NAU sponsors programs in all areas; NIFS - Undergraduate (mentored research) Scholarships; HE – Participation in the Statewide Undergraduate Research Scholar Symposium, Northern Arizona Planetary Science Alliance (NAPSA) student support at NAU Research and Design Day, Physics and Astronomy undergraduate science clubs including the AISES club (and their participation in the 1st Nations High Power Rocket Launch program) and the Society of Hispanic Professional Engineers (SHPE) club; RI – National Undergraduate Research Observatory (NURO) student support; PC - American Indian Mobile Education Resource (AIMER), Navajo-Hopi Astronomy Outreach program with Lowell Observatory, Nizhoni (native high school summer academy), and IE - Support two middle school STEM clubs and the Flagstaff Festival of Science.

Embry-Riddle Aeronautical University (ERAU): Private M.S.-granting aeronautical university and #1 ranked for aerospace, physics, engineering, and aeronautical science programs. ERAU provides two Associate Directors for AZSGC. ERAU sponsors programs in NIFS - Undergraduate (mentored research) Scholarships; HE – Statewide Undergraduate Research Scholar Symposium participant; and RI – a variety of student team flight and non-flight programs (NASA CubeSat development, the Eagle Space Flight Team, and an ASCEND team).

AFFILIATES (27):

Each affiliate provides one or more representatives to the AZSGC Statewide Steering/Advisory Committee; most collaborate in programs. FY 2019-20 program participants are indicated with (*).

Higher Education Affiliates (7): The National Undergrad Research Observatory Consortium (NURO)*: Consists of 11 total small colleges/universities from across the country; eight of its members are two-year community and tribal colleges. The RI NURO program shares observing time

on Lowell Observatory's 31-inch telescope and collaborates on key astronomical research. Diné (tribal) College*: RI ASCEND Balloon-sat program, HE Statewide Symposium. Tohono O'odham (tribal) Community College (CC)*: Annual STEM faculty-defined HE projects to enhance campus STEM courses/programs. Central Arizona CC (HSI)*, Glendale CC (HSI)*, Phoenix College (HSI)*, and Pima CC NW (HSI)*. All participate in the RI ASCEND Balloon-sat program, HE Statewide Symposium, and provided AZSGC statewide meeting participants.

Industry Affiliates (6): Iridium Satellite LLC* (AZSGC Alumnus Rep): NIFS selects ASU Undergrad and Grad Scholars. Northrop Grumman* (AZSGC Alumnus Rep): RI ASCEND balloon-sat program, HE Statewide Symposium moderator, AZSGC statewide meeting participant. Paragon Space Development Corp: NIFS selects UA Undergrad and Grad Scholars, mentor placements for students, HE working in industry talks to UA SG students. Raytheon Corp: HE working in industry talks to UA SG students. Rincon Research*: NIFS selects UA Undergrad and Grad Scholars, mentor placement for students. World View (AZSGC Alumnus Rep): occasional mentor placements for students and working in industry talks to UA SG students.

Outreach Affiliates (6): AZ Daily Star* and AZ Daily Sun* (Tucson and Flagstaff newspapers): NIFS mentored, science writing placements for students, HE Research and Design Day, IE Festival of Science. Biosphere 2* (Earth science research, education, and science center): IE displays AZSGC Lunar Greenhouse Outreach and Teaching Module, mentor placement for UA Graduate Scholar, NIFS selects UA Grad scholars. Flandrau Planetarium and Science Center*: supports and provides cost-sharing for HE NIFS supplemental experiences, mentor placement for UA Graduate Scholar. Mt. Lemmon Sky Center*: NIFS selects UA Undergrad and Grad Scholars, mentor placement for UA Graduate Scholar, occasional PC/IE Grad Scholar-led STEM educational program at the facility. Prescott Astronomy Club*: IE open invite to all club events/activities and funds NAU HE awards, AZSGC statewide meeting participant.

Research Affiliates (8): AZ Near Space Research*: 501(c)(3) organization; promotes science, technology, engineering and mathematics (STEM) through Amateur Radio and High-Altitude Balloons; HE Statewide Symposium moderator; RI ASCEND balloon-sat program; AZSGC statewide meeting participant. DOE Legacy Management* (Federal) (AZSGC Alumnus Rep): NIFS opportunities, HE Symposium attendee and mentor. Lowell Observatory*: NIFS mentored research projects for Undergrad Scholars, HE Statewide Symposium moderators, and NAU Research and Design Day, IE Festival of Science, PC Navajo/Hopi program, RI NURO program. National Optical Astronomy Observatories*: (Federal) NIFS occasionally mentored research for Undergrad Scholars, IE educational programs and tours for Space Grant groups. Planetary Science Institute* (NPO): occasional NIFS mentored research projects for Undergraduate Scholars, HE leads industry talks to UA SG students. USDA Southwest Watershed Research Center* (Federal): Provides UA Space Grant Associate Director, NIFS mentored research placements, leads Scholars' Peer Advisors program, HE helps lead Undergrad Scholarship program orientation, abstract writing, and PowerPoint development/presentation workshops. U.S. Geological Survey Astrogeology Science Center* (Federal): occasional NIFS mentored research placements, IE Festival of Science, HE Research and Design Day and Statewide Symposium moderators. Northern Arizona Planetary Science Alliance (NAPSA)*: HE program; talks and research posters presentations; involves NAU NIFS students in leading-edge planetary science.