



Report of the NASA Program Definition Team for Student Collaborations

The CubeSat Perspective

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SC Team membership

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History

- Program Definition Team formed Spring '07
- Charter:
 - Develop a white paper capturing best practices in project-based learning exemplifying the nature of NASA's scientific exploration (i.e. science AND engineering instrumentation).
 - Explore additional learning opportunities of a similar character that is not part of a flight mission.
 - Provide opportunities for input from the community engaged with NASA Science Mission Directorate (SMD), including conducting an open workshop.
- Interim Report released 11/07
- Community Meetings 12/07, 01/08
- Final Report release 04/08
- One goal: to inform and shape future NASA Announcements of Opportunity

How is this relevant to the CubeSat community?

- Helped define “best practices” -- CubeSat programs (and general model) were viewed as good examples of student collaborations
- SCDT and the CubeSat community share several concerns, notably improving access to space for student payloads
- Depending on the specific AO, NASA SMD *may* be a source of future funding for CubeSat missions

What are student collaborations?

- Definition is broad and flexible
 - Engineering, science, mission operations
 - Suborbital, satellite, data collaboration
- Emphasis on high-quality projects that involve students in multiple segments of the mission from scientific formulation, to mission planning, to systems engineering, to design and development of flight hardware, to qualification, test and integration, mission operations, to ground truthing and data analysis.

One iconic example: New Horizons Student Dust Counter

- SDC funded as an E/PO project for the New Horizons Pluto mission
- Designed and built by University of Colorado students
- On its way to Pluto



Student Collaborations as a Primarily Educational Experience

- *4.1* Student Collaborations are an important educational experience for undergraduates. Whether focused on for-flight hardware, science collaboratives or mission operations, these programs represent a unique opportunity to students gain real-world experience that will prepare them for the workforce as scientists, engineers, systems engineers, or program managers. A key ingredient of SCs that distinguishes them from the normal academic experience is that individual students learn the necessity of participating as members of an interdisciplinary team to achieve success in the development of a complex system.

Selected recommendations for NASA

- 3.1. Student Collaborations should be encouraged throughout NASA SMD.
 - 3.1.1. *Opportunities for Student Collaborations should be included in SMD missions, as components of suborbital programs, as stand alone ROSES opportunities, and as part of instrument development programs, like the PIDDP program.*
 - 3.1.2. *Student Collaborations should be focused at the undergraduate level, with allowances to enable flow down to high school efforts and/or up to graduate students.*
 - 3.5.2. *While many kinds of programs should fit into the definition of a Student Collaboration, hardware programs represent a critical experience not easily replicated in other science-based programs. Student Collaboration language in AOs for SMD programs should give priority to programs involving students in the design of valid experiments or the design and development of flight systems.*

Access to space

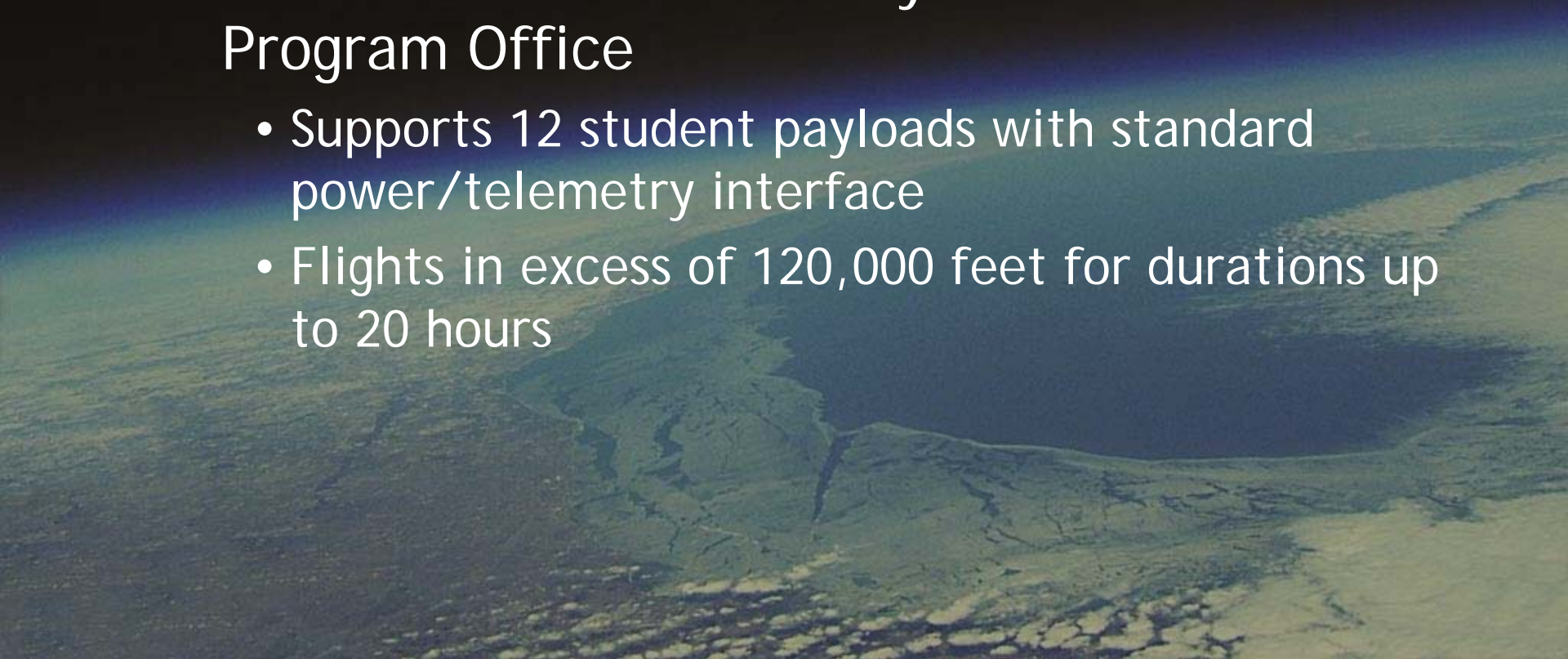
- 3.6. Access to space remains one of the most critical elements for sustaining Student Collaboration instrument programs. NASA can play a critical role in facilitating opportunities for Student Collaborations, both within and outside the agency.
 - *3.6.1. NASA should invest in standardized, robust accommodations on existing US launchers, aircraft, high altitude balloon platforms and sounding rockets.*
 - *3.6.2. NASA should include accommodations for SC payloads on new and existing NASA-procured launch vehicles and possibly spacecraft.*
 - *3.6.3. NASA should encourage U.S. launch vehicle suppliers to add standardized provisions for university-based educational payloads to their vehicles.*
 - *3.6.4. NASA should make surplus and prototype NASA flight hardware available to Student Collaboration projects, and establish policies that encourage non-NASA entities to do the same.*

Access to “space like” environments

- *While ultimately there is no substitute for access to space in encouraging the next generation, there are synergies between flight and flight-like platforms that should be exploited.*
- [Excellent for building the technical and program management experience leading to CubeSat development and flight, and in priming the educational pipeline to supply CubeSat developers]
- Near ground systems
 - Environmental test chambers
 - Mid-altitude aircraft
 - Reduced gravity aircraft
 - High altitude aircraft

Suborbital systems

- Balloon platforms
 - High Altitude Student Platform (HASP), Louisiana State University/NASA Balloon Program Office
 - Supports 12 student payloads with standard power/telemetry interface
 - Flights in excess of 120,000 feet for durations up to 20 hours



Suborbital systems (cont.)

- High altitude weather balloon “satellites”
 - Flights in excess of 100,000 feet
 - Low development and program costs



High school students in Adler's Astro Science Workshop built and launched payloads on two high altitude weather balloons in Summer 2007

Suborbital systems (cont.)

- Sounding Rocket Platforms. Although other launch sites are available, Wallops has historically provided the largest amount of sounding rocket access and is considering extending this access for educational opportunities. Flights and support have generally come from E/PO budgets and are “fit in the margins.”
 - Microgravity Enterprises, Inc. (MEI). The role of commercial companies in microgravity flights is something that should be explored. For example, MEI offers flight opportunities offset by sales of products marketed as space products.

Low Earth Orbit systems

- International Space Station
- ARES and future flight systems tests – fly hardware as part of test flights
- CubeSats and NanoSats
 - NSF has released a call for proposals involving CubeSats
 - Air Force's University Nanosat program
 - NASA participated in past University Nanosat programs, but no longer
- SMEX and other observatories

Deep Space systems

- New Horizon's Student Dust Counter was the first student instrument to ride on a deep space mission
- Student Collaborations on Scout-, Discovery-, and New Frontier-class missions have tremendous potential to add to the NASA Space Exploration Visions, the Moon and Mars.

Conclusion

- Student Collaborations provide undergraduate students hands-on experiences that give them important skills to ready them to enter the space industry.
- NASA has a unique leadership role to facilitate student programs both within the Agency and across the community to insure that a broad and diverse group of students are able to participate.
- A broadly-based Student Collaboration Program is recommended that would involve undergraduate students in authentic research opportunities that increase their interest in scientific and technical careers and enthusiasm for space exploration, while equipping them with first-class engineering and science skills that are unique to the work that the agency conducts.