Teachers in Space: Standardized Classroom Cubekits for Balloon, Glider, Suborbital Flights and Orbital Deployment

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Abstract

Low cost spaceflights and experimental equipment are enabling a new generation of scientists, technologists, engineers and their teachers to work with live satellites and conduct their own research. TIS' standardized cubesat Cubekit with electronics approved for flight on multiple vehicles enables teachers and students to focus on research rather than on building experimental craft. High school students report that pictures and essays from their research are earning them the college interviews and acceptances they seek to pursue STEM education and careers. Here, we provide details on the flight testing of Teachers in Space's 1 and 2u Classroom Cubekits for balloon, Perlan 2 glider, and New Shepard rocket. We will also give a glimpse into the development and qualification testing of our first 3u orbital Cubekit due to deploy this year from Firefly Aerospace's inaugural flight.

Why Standardize Scholastic Flight Experiments

Cubesats built at universities may cost $500,000 or more (including launch) over two years. Sourcing components, conducting qualification and acceptance testing, and completing design and safety review with flight providers take significant work and introduce multiple opportunities for error and failure. The long timeline, high budget, and reported 40% failure rate puts such projects out of reach for most high school engineering and robotics programs. A standard, tested and approved classroom cubesat kit (TIS' Cubekit) eliminates most build and testing, enabling teams to focus on configuring their data collection. Learners can assemble and fly a suborbital radiation sensing experiment in a matter of months, for under $10,000, receiving data via real time streaming or as a spreadsheet immediately post flight. TIS' standardized Cubekits let teams study and build on others' work, compare results, and collaborate to troubleshoot issues. Curriculum can be shared across locations. Experiments can be built once for readily available flights on various vehicles, and can easily be grouped for practice in flocking logic or for comparing sensor variations. Schools can better estimate time, cost, and likelihood of success, improving funding options, parental support and student participation.

Flight Providers for the Classroom Cubekit

Classroom experiments built from TIS' standard 1u cubekit have successfully flown with multiple high-altitude balloon projects since 2012 and with Perlan 2 stratospheric glider since 2015. The 2u kit successfully flew in the Nanoracks Feather Frame aboard Blue Origin's New Shepard suborbital vehicle in May 2019. A USB integration provided access to vehicle power and flight data, while the flight profile offered a unique microgravity regime. TIS' first orbital satellite built from our Cubekit will deploy from Firefly's inaugural launch in 2020 and includes solar panels and radio communications for data transmission from orbit.

Conclusions

TIS' standard Classroom Cubekits enable school teams to build and fly stratospheric and suborbital experiments on a variety of vehicles for less than $10,000 per flight, getting data back the same day. Project durations shorten, test and review requirements reduce, and teams build a foundation for more complex and expensive orbital deployments. Students can focus their effort on the research which best prepares them for their future.

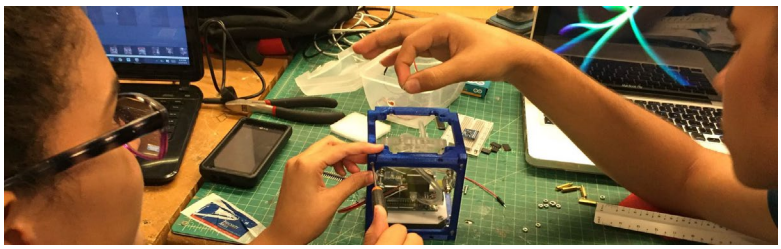

Figure Insert: Students at Forest Hills High School, New York City assemble a classroom cubekit