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## LESSONS LEARNED FROM AN UNDERGRADUATE UNIVERSITY'S FIRST CUBESAT

**Abstract**

On January 31, 2019 the University of Southern Indiana UNITE CubeSat was deployed from the International Space Station and began transmitting within the first hour. The threefold mission of UNITE (Undergraduate Nano Ionospheric Temperature Explorer) is to measure plasma properties in the lower ionosphere using a Langmuir plasma probe, measure its internal and skin temperatures to compare with a student-developed thermal model, and to carefully track its orbital decay so that CubeSat drag models can be updated. The 3U UNITE CubeSat is magnetically and aerodynamically passively stabilized. UNITE is the first CubeSat designed and orbited by undergraduates at the University of Southern Indiana. This paper will summarize the lessons learned during the design, build, integration, test, delivery and early operational phases of the UNITE project. The all-undergraduate team designed, fabricated, tested and integrated the command board, solar panels, and temperature sensor array. In addition, the team integrated a magnetometer and GPS. A commercially purchased Electric Power Subsystem provides Maximum Power Point Tracking. The same commercial vendor was the source of a simplex and duplex system that transmits through the GlobalStar satellite network allowing nearly 24/7 communication with UNITE. The team wrote and tested the flight software which is divided into five primary modes covering the entire mission. Orbital simulation is a key input to ground software calculation of attitude and attitude rates, as well as the thermal model. Among the challenges were a fire in the CubeSat just before environmental tests were to begin, and the need for an unplanned vibration test of the entire CubeSat normally intended for the batteries, resulting in a small amount of debris that had to be removed. Further the functioning GPS unit was discovered to be unable to achieve lock shortly before delivery. Even with all the setbacks and unexpected events the UNITE team was able to learn from these faults. In future missions the UNITE team has learned that strong communication, documentation, and testing is key to a successful mission.