

# **Title:** Microgravity Research Environment Payload

**Sponsor:** Jeff Ganley, The ACCESS for Education Foundation / Microgravity Enterprises, Inc.

## **Overview**

Recent microgravity research has shown that promising research areas exist for sub-orbital and/or orbital return missions which take advantage of the microgravity environment of space. These areas include the production of novel and/or improved pharmaceuticals, metallurgy, crystal growth, protein growth, nanomaterials, etc. However, these microgravity research areas are almost entirely unexplored in that they focus on potential commercial applications that utilize the space environment. Past and present research experiments that have utilized NASA and/or Air Force launch vehicles have, by design, addressed Government research interests. These experiments/missions have by definition not addressed the potential commercial applications listed above, as this would have represented a conflict of interest for the Government agencies providing the launch.

As an example of how the system has and is currently functioning, consider a recent NASA experiment that was launched in September of 2006 on the Space Shuttle (STS-115), and was designed to measure the effects of microgravity and other aspects of the space environment on salmonella bacteria. The experiment results were that the salmonella did indeed show increased virulence due to spending their life cycle in the microgravity environment of space. This result is interesting and has clear application for future long duration space flights. What is missing from this paradigm, however, are more near term applications which likely hold similar promising results. One potential example is protein and/or crystal growth for pharmaceutical applications, the foundations of which (i.e. crystals and proteins grow larger and more pure in a microgravity environment than in the 1g environment of Earth) have already been clearly established.

Under the ACCESS for Education Program, Microgravity Enterprises, Inc. will be providing regular sub-orbital short duration (2-3 minutes nominal, 5-10 minutes maximum) access to the microgravity environment of space. The goal of the ACCESS Program is to foster and implement commercial application focused microgravity research and development using these flight opportunities. This will in turn establish the theoretical research foundation for future commercial applications that utilize the microgravity environment of orbital and/or sub-orbital space flight.

As a first step in the ACCESS Program, the sub-orbital rocket flight environments (i.e. temperature, pressure, inertial loading, etc.) first need to be characterized. In this project, you will design a payload that is capable of measuring and recording some or all of the relevant rocket flight environment(s). This data will be used to support the design of future ACCESS research experiment payloads. In addition, the design of the environment payload can serve as an initial step for programs to gain experience and mature toward the eventual design of the commercial microgravity research payloads mentioned above.

## Requirements

The top level requirements for the microgravity research environment payload are summarized below. Your design work should flow directly from these requirements.

1. The microgravity research environment payload shall conform to the requirements as specified in the “ACCESS for Education Payload User’s Guide,” Rev. -, January 2008. Detailed programmatic, as well as mass, volume, interface and environment specifications can be found in the User’s Guide.
2. The ACCESS for Education Payload User’s Guide is meant to convey all ACCESS Program requirements. Requirements questions that cannot be answered by the ACCESS Program User’s Guide should be directed to the ACCESS Program Coordinator, Jeff Ganley (505-239-8159, [jeff.ganley@ACCESSforEducation.org](mailto:jeff.ganley@ACCESSforEducation.org)).

## Major Tasks

1. Conforming to the requirements in the ACCESS for Education Payload User’s Guide, design an experiment payload which is capable of measuring and recording the relevant rocket flight environment(s) given in Appendix A of the ACCESS for Education Payload User’s Guide. These environments include the temperature, pressure, noise, quasi-static inertial loading, random vibration and shock loading.

## Expectations

1. Perform a detailed design of the selected microgravity research environment payload, including drawings, parts lists, and supporting analysis.

## Groups

Once the microgravity research payload is chosen, the following subsystem groups may be designated:

- Microgravity Research Environment Payload Environmental Characterization Subsystem(s) (one for each measured environment)
- Microgravity Research Environment Payload Mechanical / Structural Subsystem
- Microgravity Research Environment Payload Power / Electrical Subsystem
- Microgravity Research Environment Payload Computing / Data Collection Subsystem

## References

1. “ACCESS for Education Payload User’s Guide”, Rev. -, The ACCESS for Education Foundation, January, 2008.

2. "UP Aerospace SpaceLoft XL Mission Planner's Guide", Rev. 2.3, UP Aerospace, Inc., 2006.
3. Wertz, James R. and Larson, Wiley J., *Space Mission Analysis and Design*, 3rd Edition, Microcosm Press, El Segundo, CA, 1999.
4. Marianna Long, John Bishop, Tattanahalli Nagabhushan, Paul Reichert, G. David Smith, Lawrence DeLucas, "Protein Crystal Growth in Microgravity, Review of Large Scale Temperature Induction Method: Bovine Insulin, Human Insulin and Human Alpha Interferon," *Journal of Crystal Growth*, 168 (1996), pp. 233-243.
5. Dr. Baruch S. Blumberg, Dr. Kenneth M. Baldwin, "Summary Report of the Workshop on Space Biology on the Early International Space Station," NASA Ames Research Center, Moffett Field, CA, March 14-15, 2002.
6. Randolph E. Schmid, "Germs Taken to Space come Back Stronger," *The Associated Press*, Washington, 24 September 07.

## **Links**

<http://www.microgravityenterprises.com>

<http://www.accessforeducation.org>

<http://www.upaerospace.com>