Research Goals
- To measure the growth of a cell population which is being exposed to radiation in orbit and compare to an identical population growing on Earth.
- To continue collecting radiation data until the end of the satellite’s life to better model the space radiation environment.

Payload Design
The payload will allow the cells to be stored and launched in an inert state and then activate them at a controlled time during the mission. Before activation, the cells will be kept between 20 °C and 40 °C. Once the cells are activated, the payload will allow for growth readings and keep the sample within a tight temperature range around 30 °C.

Payloads
The complete payload will consist of an array of around 18 identical sample modules, each containing the same type of cells. Each will be a self-contained system with its own thermal control, growth sensors, activating chemical and mixing mechanism. This module design will be repeated to achieve the desired number of samples and all modules will be combined together to form the complete payload. The central cylinder and attached components will contain the cells and their suspending fluid.

Thermal Control
- Passive thermal control deemed acceptable for the CubeSat bus leveraging thermal straps and MIL
- Active thermal control required for science payload
  - Temperature limits: 30±0.25 °C
- Active thermal control:
  - Flexible polyimide patch heater wrapped around sample cuvette; controlled using a PV controller linked to a thermistor embedded within sample
  - Minimal power consumption at steady-state and initialization

Radiation Exposure
To fulfill the mission’s primary goal, preliminary estimates for Alpha and Beta radiation were obtained using Systems Tool Kit Space Environment and Effects Tool utilizing the NASA Computational Model.

Introduction
The ability to sustain human habitation outside of Earth for future manned missions, requires a deeper understanding of how the space environment affects living organisms for long periods of time. To understand these effects, 12-18 biological samples will be deployed on a 6U CubeSat platform with sensors to detect radiation and cell population growth. The samples will be activated in sets of three every two weeks to allow radiation damage to accumulate. To aid with understanding the data received by the CubeSat, an identical experiment will be run on Earth to allow a comparison of the results.

CubeSat Project Overview
1. Deliver to Launch Authority
2. Launch to ISS
3. Deploy from ISS
4. Perform Science Experiments:
   1. Cell Growth
   2. Measure Radiation Environment
   3. End of Life Radiation Sampling and Orbital Decay
5. Return to Earth

Future Testing
Facilities available for thermal and vacuum testing purposes are located in Embry-Riddle Aeronautical University’s research complex, the Micapelx. The research park has a 36”x36”x36” stainless steel chamber capable of reaching pressure levels as low as 10-7 Torr which is well within our expected orbital pressure environment. It is able to reach such low vacuum levels because it features German precision roughing and turbo pump technology.

Prototyping
The prototyping procedure has been broken up into three general phases. Efforts in the first phase will focus on simply constructing the plastic cuvettes. In the second phase, the solenoid valves and micro pumps will be attached to the prototype cuvettes along with the necessary tubing. The final stage will see the addition of the thermal system and spectrophotometry equipment. Through funds acquired from an Embry-Riddle Spark Grant and operational funds from Dr. Castillo’s lab, most of the parts necessary for all three stages of prototyping have been acquired.

Thermal Cycling
- PHASE I - Cuvette Construction
  - Leak-Proof Construction
  - Autoclaving
  - Cell Growth
  - Pressurization
  - Spectrophotometry
- PHASE II - Pumping Mechanism
  - Leak-Proof Construction
  - Autoclaving
  - Sample Separation & Purging
- PHASE III - Thermal and Detection Systems
  - Thermal Cycling
  - Spectrophotometry
  - Structural Integrity

Micapelx
- COMPLETED
- PLANNED

Since the components of the pumping system have not yet been acquired, the prototyping effort is still in phase 1. Close to 60 prototype models have been constructed using a variety of construction methods and solvents. These models have been tested for their basic structural integrity, ability to withstand autoclaving and resistance to leaking. E.Coli cell colonies have been grown over periods ranging from a few days to a week in laboratory incubators. These populations have exhibited growth behavior that is expected from healthy cells. Their growth has been measured and confirmed by spectrophotometry.