Lessons Learned from 2013

- Consider the effect of vibrations on electronic components
- Map out a testing system early on
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Mission Overview
Bacteria

“To determine the effect of microgravity on the reproduction rate and overall activity of a simple bacterium”

Mission Requirements

- Allow for comparison of bacterial samples at various stages of flight
- Determine the conditions needed for a bacterial sample to reproduce under alien conditions
Bacteria

What we expect to discover
  o The effect of minimally dampened ascent/descent into space on bacterial samples
  o The effect of microgravity on bacterial samples

Benefit
  o Establish a new methodology for bacterial experiments in space
Graphene

“To determine the structural stability of graphene through a minimally dampened ascent and descent”

Mission Requirements

- Establish a reliable way of testing the stability of graphene so that the sample is not destroyed
Graphene

What we expect to discover

- The overall effect of space travel on the structure of graphene produced and transferred via different methods (determined by Raman spectroscopy).
- Also, the times on the trajectory when the structure is compromised via optical reflection change.

Benefits

- Determine the feasibility of using graphene in future electronics in perturbative systems.
Theory and Concepts

Bacteria

- In microgravity, it has been shown that bacteria have decreased lag time and increased proliferation.
- Due to low gravity, the structures of clusters of bacteria are less restrictive to movement along the z-axis.
Theory and Concepts

Graphene

- Graphene consists of single or few layers of carbon atoms arranged in a hexagonal lattice. It has remarkable mechanical, electrical, thermal, and optical properties which make it promising for use in next generation technology.
- These properties are limited by the structural integrity (measured by the defect density) which can be determined by Raman spectroscopy.
Mission Requirements

● Test the effects of microgravity on bacteria reproduction and structure
● Test the mechanical properties of graphene
Concept of Operations
Expected Results

- Increased bacteria reproduction
- More 3D (spherical) structures for clusters of bacteria
- Graphene deformation
Conceptual Design Overview
Bacteria Types

● **Shewanella oneidensis**
  ○ is a gram negative anaerobic bacteria which is predominantly found in deep sea anaerobic habitats

● **Saccharomyces cerevisiae**
  ○ is a species of yeast that is instrumental to wine making, baking and brewing
Containment System

- Separate samples
- Water and air proof
- Still researching for best option
Reproduction Measurement System

- Ohmmeter
- Measure change in resistance of medium due to bacteria reproduction
- Requires comparison to preliminary tests to derive bacteria reproduction
Freezing System

- CO2 Canisters
- Multiple freeze times
  - Near Apogee
  - Apogee
  - Post-Apogee
- Continuous freezing
  - To prevent melting during the possible 2-3 hour retrieval
Damping System

● Dampen samples from intense vibrations
● Basing off of systems used to dampen flight control boards in UAVs
Graphene Overview

● Photodiode measures reflected light due to deformation
Electrical Block Diagram
Payload Layout

Top plate: Power Systems

Middle Plate: Containment System and Graphene Experiment

Bottom Plate: Freezing System
Compliance

● We are closely following the RockSat-C User Guide to ensure compliance.
Shared Logistics

- Partner is unknown at this time.
- Had a great experience last time and would like to work with Mitchell CC again.
- We have planned out how communication will take place
  - Teleconferences when necessary
  - Shared 3D models throughout design phase
  - Constant emails to keep teams in sync
Work Breakdown Structure
Gantt Chart

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<thead>
<tr>
<th>Task Name</th>
<th>Duration</th>
<th>Start</th>
<th>Finish</th>
<th>Predecessors</th>
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<td>Mon 10/13/14</td>
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</tbody>
</table>
Budget

- 30 CO2 canisters for $30
- Access to Graphene from Stevens
- Bacteria costs are still being researched
- Damping system ~$200
- Containment system costs are still being researched
Conclusion
Conclusion

● Gain information on the effect of microgravity on bacteria
● Determine the feasibility of using Graphene on future electronics
Questions

- How do we start the process for clearance to use bacteria?