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The mission is to provide natural supplements (plants and probiotics metabolites extraction) testing in suborbital space to show the effects at a molecular level of gene expression change in activated immune cells.

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1.0 Mission Statement, Requirements, and Expected Results

The purpose of participating in RockSat-C is to answer our question of suborbital microgravity effects on immune cell regulation. This project is in conjunction with our existing NASA project investigating natural countermeasures to astronauts’ immune system dysregulation that is of current interest to NASA. The mission is to provide natural supplements (plants and probiotics metabolites extraction) testing in suborbital space to show the effects at a molecular level of gene expression change in activated immune cells. Project requirements are building a sounding payload system, integrate the biological experiment-human immune cells and subject to microgravity in space for 5-6 minutes.

2.0 Final Payload Design

Figure 1. Change in design from CDR. Using a Twist Lock/ X design to hold samples.

Figure 2-3. Twist-lock secondary container design. Holds the cryovial containing our biological samples. Also has a stacking capability.
Figure 4-5. 3-D printed design. The X is attached to the makrolon plate. The secondary containers are twisted on which will contain the cryovial. The secondary containers will then be enclosed with a lid. These images also demonstrate the stacking capability of the design, which will allow for more cryovials to be integrated.

Figure 6. 3D Printed design. Demonstrates how the cyrovials will be enclosed by using a lid.

3.0 Testing Results

A. Integrated Subsystem Testing Results
A vibration test was performed on the payload and the results were conclusive. Additional Biological testing listed in the appendices.
B. Full Mission Simulation Results

No Leakage was detected after doing a vibration test. Which we ran the canister up and down a rocky sidewalk, the canister even falling on the ground. (refer to figure 7-9).

4.0 Launch Readiness

A. User Guide Compliance

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Status</th>
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</thead>
<tbody>
<tr>
<td>Center of gravity in 1” mid-can?</td>
<td>In the process of checking center of gravity</td>
</tr>
<tr>
<td>Contained in</td>
<td>Yes</td>
</tr>
<tr>
<td>Connected to can by 4/5 bulkheads on top and bottom</td>
<td>Yes on the bottom plate</td>
</tr>
<tr>
<td>Mass at 20 + 0.2 lbs.</td>
<td>In the process of increasing mass to meet requirements</td>
</tr>
<tr>
<td>Shared canister clearance</td>
<td>Using full canister</td>
</tr>
<tr>
<td>No voltage on the can</td>
<td>No</td>
</tr>
<tr>
<td>Activation wires at least 4ft</td>
<td>N/A</td>
</tr>
<tr>
<td>Activation wire at least 24 gauge and Teflon coated</td>
<td>24 gauge</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Early Activation: current &lt; 1 A</td>
<td>N/A</td>
</tr>
<tr>
<td>T-0 Activation: current &lt; .1 A</td>
<td>using G-switch</td>
</tr>
<tr>
<td>Battery Type</td>
<td>Lithium Polymer (will not charge at Wallops)</td>
</tr>
</tbody>
</table>

B. Integration Plan and Procedure

Proposed plan of Integration is as followed
1. Attach plates to canister, with the X already being attached to plate.
2. Place liquids into cryovials (18)
3. Place cryo-vials into slots in the secondary containers
4. Attach secondary containers to cross or X and seal secondary containers with lid
5. Close canister

C. Action Items

Increase weight of payload to 20 lbs. and check center of gravity. We are thinking about using a ballast or some sort of weight that does not cause damage to our payload or other payloads.

5.0 Conclusions (0.5 to 1 page)

No leakage detected using secondary container method. By time of flight and testing at Wallops flight facility, our payload, that has gone through many changes this semester will be complete. Using our twist lock/ X design we hope to retrieve usable samples. If our samples are retrieved after flight, we will analyze samples on liquid chromatography mass spectrophotometry and Miniseq housed at the LU Science Research Institute. This will allow for the team to determine the chemical composition of each sample and the genetic differences, if any. This design may help to determine the effects of the spin of the rocket on the samples, based on their position in the rocket. As stated previously, the purpose of participating in RockSat-C is to answer our question of suborbital microgravity effects on immune cell regulation. This project is in conjunction with our existing NASA project investigating natural countermeasures to astronauts’ immune system dysregulation that is of current interest to NASA. The mission is to provide natural supplements (plants and probiotics metabolites extraction) testing in suborbital space to show the effects at a molecular level of gene expression change in activated immune cells. Project requirements are building a sounding payload system, integrate the biological experiment-human immune cells and subject to microgravity in space for 5-6 minutes.

6.0 Appendices
Figure 10. 2017 RockSat-C results and indicator of pH changes.

Figure 11. pH change in tubes after 2-3 days’ incubation at RT or in the presence of CO2. Tubes 1-3 incubated in CO2 for 3 days, tube 4 had a hole in lid and incubated at RT for 3 days, tube 5-7 we closed with no air/hole at RT for 3 days. The samples were transferred to be able to clearly see the difference in pH change and to determine what had caused the pH change.