**TEST EQUIPMENT DATA PACKAGE**

***Fr. Brian Reedy, SJ***

***Cristo Rey Jesuit College Preparatory School of Houston***

*breedy@cristoreyhouston.org*

*951-663-8943*

*6700 Mount Carmel Street, Houston TX 77087*

**Self-assembly of mesoscopic lipid mimics**

TEDP Completion Date: 1 October 2013

**IMPORTANT THINGS TO NOTE:**

**Avoid permanent magnets if possible**

**Avoid Shaterable materials if possible (e.g. class) However there are ways to secure these items, just be sure Mentor and NanoRacks are aware so that they can be packaged appropriately.**

**Avoid pressure vessels**

**Avoid substances with toxicity higher than 2 on MSDS’s**

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**QUICK REFERENCE DATA SHEET**

Team Name: Cristo Rey Jesuit College Preparatory Seniors

Principal Investigator: Fr. Brian Reedy, SJ

Contact Information: 6700 Mount Carmel Street, Houston TX 77087

Experiment Title: Self-Assembly of Mesoscopic Lipid Mimics

Work Breakdown Structure (WBS):

Flight Date(s): Thursday 8 May 2014

Overall Assembly Weight (lbs): TBD

Assembly Dimensions (L x W x H): 10cm x 10cm x 10cm

Equipment Orientation Requests in reference to NanoRack: TBD

Proposed Mounting to NanoRack: TBD

Does Experiment need to be located next to fan on NanoRack: (Yes or No) NO

Power Requirement (Voltage 9and Current Required): TBD

Camera or Video Requested? (Yes or No): NO

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**BASIC MISSION OBJECTIVE:**

The goal of this project will be to investigate cellular formation, and other self-assembly events, using mesocopic mimics of lipid structures. In the absence of the shearing forces due to gravity we predict that we will be able to observe novel self-assembly patterns and be able to collect original data.

**EXPERIMENT BACKGROUND**

We believe that this project will yield novel data about self-assembling structures. Some of the reasons that macro- or mesoscopic self-assembly should be investigated are presented in a paper by George M. Whitesides of Harvard University (16 April 2002). In that paper he lists six reasons that these experiments are interesting. They are summarized as follows: First, nonmolecular systems allow tests of hypotheses about self-assembly that cannot be carried out with molecules and extend our understanding of the fundamental, abstract concepts of self-assembly. The second reason is experimental convenience. It often is easier to fabricate nonmolecular components than it is to synthesize molecules, and easier to observe the process and products of self-assembly using these large components. Indeed, we will be 3D printing our mimics and will be able to observe their behavior with slight magnification. Third, self-assembly offers routes to ordered states of matter; it thus has specific application in important problems in materials science, condensed matter science, and engineering. Fourth, self-assembly shows every promise of playing a key role in nanoscience and nanotechnology. Fifth, self-assembly offers a possible route to the fabrication of three-dimensional (3D) microstructures. Sixth, a number of problems in manufacturing including problems in robotic assembly may be aided by self-assembly. Whitesides concludes the section of his paper by stating specifically, “It may even be an interesting strategy for the assembly of large structures in environments (for example the microgravity of space or the ocean) where lateral mobility is relatively unhindered by the effects of gravity and friction.” Our research has not proffered any indication that, to date, any such experiment has been conducted in microgravity.

**EXPERIMENT DESCRIPTION**

We plan to 3D print small (millimeter range) “lipid” structures that have a magnetic “head” and an electrostatic “tail.” We will then construct an assembly chamber in which we can allow the “lipids” to self-assemble into stable macrostructures. We will manipulate the “lipids” by collecting them with an electromagnet into a side chamber. We will vary the effective concentration of lipids by adjusting the size of the container. We will free the “lipids” from direct interactions with the container using an eccentric motor vibration device. This device will also provide some energy to allow the structures to move about the chamber and encounter each other. The variables we will change will be: the number or effective concentration of “lipids” in the interaction chamber; the field strength of the electromagnet; the vibration frequency of the eccentric motor.

**OPERATIONAL SCENARIO**

1. *High Level Summary of Payload Operations, general overview*
2. *Specific constraints for payload (ie. Activation requirements, temperature requirements to/on/from ISS, orientation requirements during transport to ISS)*
3. *How long does the experiment need to operate for? Does the experiment require any crew interaction?*

**We need a minimum of 10 days of experimentation.**

1. *Will payload need to be returned or disposed of once ops complete*

**Yes, we would like for the payload to be returned to us.**

1. *What kind of data needs to be collected during the mission and will ground operations be required (ie. Downlinking to NanoRacks mission control?)*

**The ardulab will be fully automated and it will collect all data. The data will need to be downlinked to NanoRacks mission control.**

**EQUIPMENT DESCRIPTION**

1. Ground-Based and Flight Equipment (if there is no difference just reference the flight Equipment. Please make excel spreadsheet for all categories of the equipment.)
   1. Pictures
   2. Descriptions of each piece of equipment
   3. Dimensions
   4. Mass
   5. Hardware Class (different classes based on toxicity of material)
2. Equipment Layout for Take-off, in Flight, and Landing (some of this information provided by NanoRacks. Equipment may be stowed in flight stowage bag during liftoff and landing. Show how the ardulab should be interfacing the NanoRack with orientation. Diagrams are helpful.
3. Special Handling/Special Hazards/Special Requirements

*Crew handling during mission? Will crew be handling toxic materials?*

1. Bio/Chemical Contents :

*Complete JSC form 27472 if applicable and provide MSDS . Avoid substances with toxicity higher than a 2 on MSDS form.*

1. Inventory of In-flight Items

*Any extra materials that will need to be stowed outside of the ardulab? If you have items that are going to be operated by the crew outside of the module provide a sketch or enough details to create a drawing. Photographs are great if available.*

**ELECTRICAL ANALYSIS**

1. Schematic drawing with all current and voltage draws
2. Load Table
3. Stored Energy
4. Electrical Kill Switch

*How will experiment be turned off in event of an emergency?*

1. Loss of Electrical Power (Fail-Safe)
2. TRY TO DESIGN without Batteries and just use the NanoRacks platform with USB power. If Batteries cannot be avoided, please include the following information and specifications:
   1. Schematics of entire unit must include the batteries (if batteries are rechargeable, include the schematics of the battery charging circuits).
   2. Protection circuit
      1. Manufacturer, details, and model number
      2. Schematics
      3. Voltage and current cutoff levels
   3. Battery type and configuration
   4. Battery manufacturer
   5. Battery history
      1. Testing history, including reports
      2. Previous NASA use, if any.
      3. Lot and cell Data
   6. Specifications on any active thermal system (N/A if no heater internal to Module experiment.)

**INSTITUTIONAL REVIEW BOARD**

*Only for human or vertebrate animal test subjects.*

**HAZARD ANALYSIS**

1. General Hazard Identification Checklist

[*http://jsc-aircraft-ops.jsc.nasa.gov/Reduced\_Gravity/docs/NS-STO-CH01.pdf*](http://jsc-aircraft-ops.jsc.nasa.gov/Reduced_Gravity/docs/NS-STO-CH01.pdf)

**TOOL REQUIREMENTS**

1. Additional Tools that will be required in flight for crew monitoring of the project.

**PHOTO REQUIREMENTS**

1. Camera/Video required? How often during mission required?
2. Downlink Requirements
3. Still/Video Photographer Special Requests

**HAZARDOUS MATERIAL**

*List any hazardous material being used and it hazard number associated with it. Include MSDS sheet for that material in section below.*

**MATERIAL SAFETY DATA SHEETS (MSDS)**

**EXPERIMENT PROCEDURES DOCUMENTATION** *This section is to include procedures for all aspects of the experiment from shipping to KSC to unloading and return to Houston. Please be specific about all procedures, especially those procedures that need to take place while on the Space Station. If there are not specific aspects to consider then please put N/A*

1. Equipment shipment to KSC
2. Ground Operations while at KSC
3. Loading/Stowing
4. Pre-Flight
5. Ascent (Launch)
6. On-Orbit
7. Descent (Return/landing)
8. Post-Flight
9. Off-Loading
10. Emergency/Contingency

**BIBLIOGRAPHY**

George M. Whitesides and Mila Boncheva, “Beyond molecules: Self-assembly of mesoscopic and macroscopic components,” *Proceedings of the National Academy of Science USA*, 2002 April 16; 99(8): 4769-4774.

Whitesides G M, Simanek E E, Gorman C B., *NATO Advanced Study Institute on Chemical Synthesis: Gnosis to Prognosis*. Chatgilialoglu C, Snieckus V, editors. (Dordrecht, the Netherlands: Kluwer; 1996), 565–588.

**DEVIATIONS/EXCEPTIONS/WAIVERS**

*Include any waivers or exceptions documentation from CASIS, NanoRacks, or NASA JSC if applicable.*