MIT Portugal NanoLab Student Payload Competition Guidelines

Background

Blue Origin is developing the *New Shepard* suborbital space launch vehicle and is launching scientific and educational payloads to space. The MIT Portugal NanoLab student payload competition allows for a Portuguese university student team to fly their nano-experiment on a 10.16 x 10.16 x 20.32 cm (4.0 x 4.0 x 8 inch) payload inside the NanoRacks Feather Frame.

This is an exciting and unique opportunity as space provides access to environments that cannot be replicated here on Earth. Since the earliest days of spaceflight, scientists and engineers have taken advantage of the unique flight environment to explore new ideas and test new technologies.

When spacecraft (and their payloads) are in free fall in orbital or suborbital trajectories, they experience accelerations much smaller than when they are on Earth. We call this environment "microgravity". In microgravity, denser things do not sink and less dense things do not rise; gravity-induced sedimentation, convection, and buoyancy are absent. As a result, microgravity is a valuable tool for exploring the way that physics and biology work at their most fundamental levels. Among other things;

- We can form new alloys without layers, create cool spherical flames, and make unique mixtures of solids, liquids, and gases.
- Biological systems respond to the novel environment of space by altering gene expression, tissue homeostasis, and organismal behavior.
- Engineering systems can be designed to take advantage of different dominant forces, like the way surface tension and capillary action dominate fluid flow.

In the early days of spaceflight, only the world's largest governments could get to space. Today, commercial launches are opening this door wider than ever before. Blue Origin offers the opportunity to launch science and engineering projects aboard its reusable spacecraft, New Shepard. On an increasingly frequent basis, New Shepard launches from western Texas to an altitude of more than 100 km (62 miles). On the way up, payloads experience nearly 3g. For three minutes at apogee, they experience less than 0.001 g!

There are many things you might explore in 3-4 minutes of free fall. Some potential experiments include the following:

- Release balls of colored liquids to explore fluid dynamics
- Explore the collisions of simple objects like beads or rubber balls
- Melt a low temperature polymer or wax in the absence of convection
- Create zero-g art or musical compositions
- Explore the basic physics of a mass on a spring under variable g-loads
- Examine capillary action with liquids of different properties
- Test technologies for a future ISS mission or CubeSat

To ensure that your experiment does not negatively impact others' experiments or the safety of the flight, Blue Origin has imposed some additional constraints, e.g., no leakage, minimal electromagnetic output, no hazardous chemicals, no stored energy, no biohazards. Keep it simple, focus on the ways that spaceflight will affect your system, and test in the lab (normal side up and upside down) to ensure good results!

Competition Details
The competition will be comprised of two (2) rounds. Upon completion of this Round 1 entry form, teams will be selected to move forward and will be matched with an MIT student team member. Together with the MIT team member, the teams will prepare a more detailed, second round proposal for review. The final team will be announced on May 1, 2019 and will receive $1,000.00 USD towards their research development. A detailed list of milestones is provided below.

More information can be found on the **MIT Portugal** website.

Competition Rules:

- No leakage
- Minimal electromagnetic output
- No stored energy
- No hazardous chemicals or biohazards
- Nano-experiments must be 10.16 x 10.16 x 20.32 cm with a total mass of less than 0.5 kg
- Liquids under 5mL
- All applications materials must be in ENGLISH only

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KEY MILESTONES

Competition Announcement in Portugal	Jan 18, 2019
First Round Entry Form & Proposals Due	Feb 18, 2019
Second round team selections announced	March 1, 2019
Second round due (with MIT team members input)	April 1, 2019
Finalist Team Announced	May 1, 2019
Initial Payload Data Packages Due from finalist team	L-5mo (July 1)
Interface Control Document drafted	L-4mo (Aug 1)
Final Payload Data Packages Due	L-3mo (Sept 1)
Final Hardware due	L-1mo (Nov 1)
Flight (L-0)	Late Q4 2019-Q1 2020

Good Luck Teams!