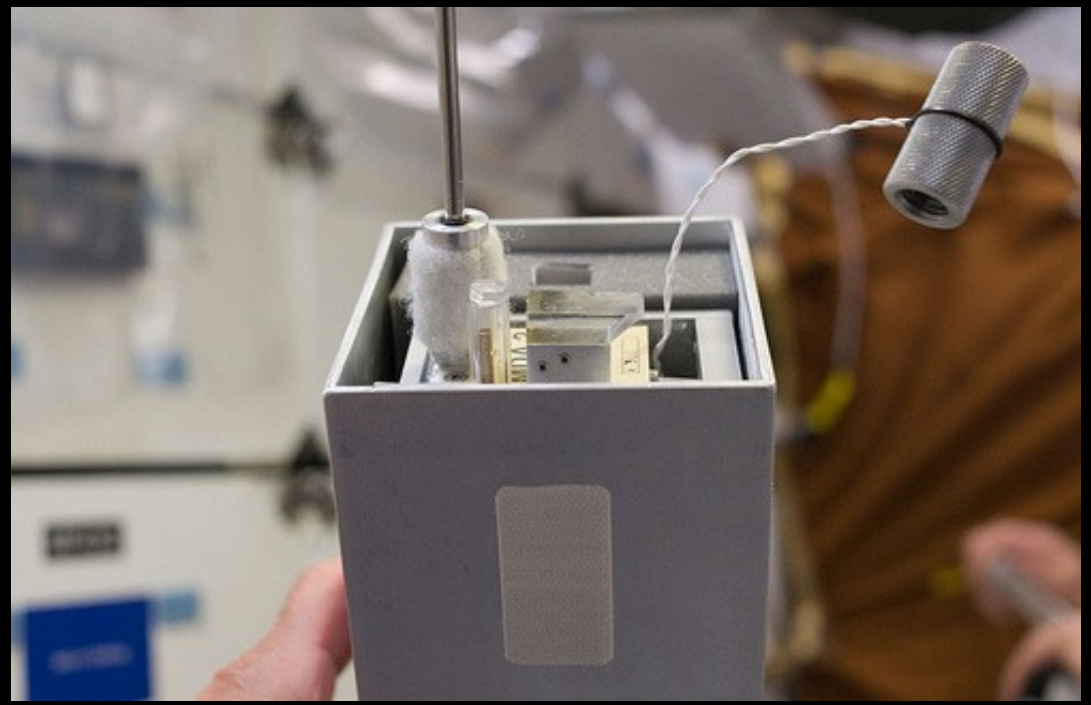
HOW TO BUILD A NANORACKS PAYLOAD: NANOLABS

NANORACKS

WELCOME TO NANORACKS

We started NanoRacks to create a commercial environment for economical space utilization. It is vital to have a cost-efficient means to utilize the space environment. We utilize plug and play, miniaturization, standardization and commercial practices to assure space operations for today's challenges.



EDUCATIONAL OVERVIEW

NanoRacks fully supports student-conducted experiments that focus on microgravity as a variable. Experiments usually fall into one of these three categories:

- **Technology Demonstration** (Air, Water, Surface Monitoring, Radiation Measurement, Communication & Navigation, Satellite Technologies, Spacecraft Materials, Robotics & Imaging, Orbital Environment, Avionics & Software)
- **Biology and Biotechnology** (Microbiology/Cellular/Other, Animal Biology, Plant Biology)
- **Physical Sciences** (Combustion Science, Material Science) and Astronomy.

- To learn more about our educational opportunities, please visit www.DreamUp.org, the Educational Arm of NanoRacks

NANORACKS OPERATIONS

Launch

Delivery

On-Orbit Operations

Return

Landing

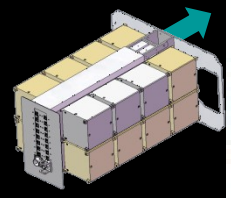
Retrieval

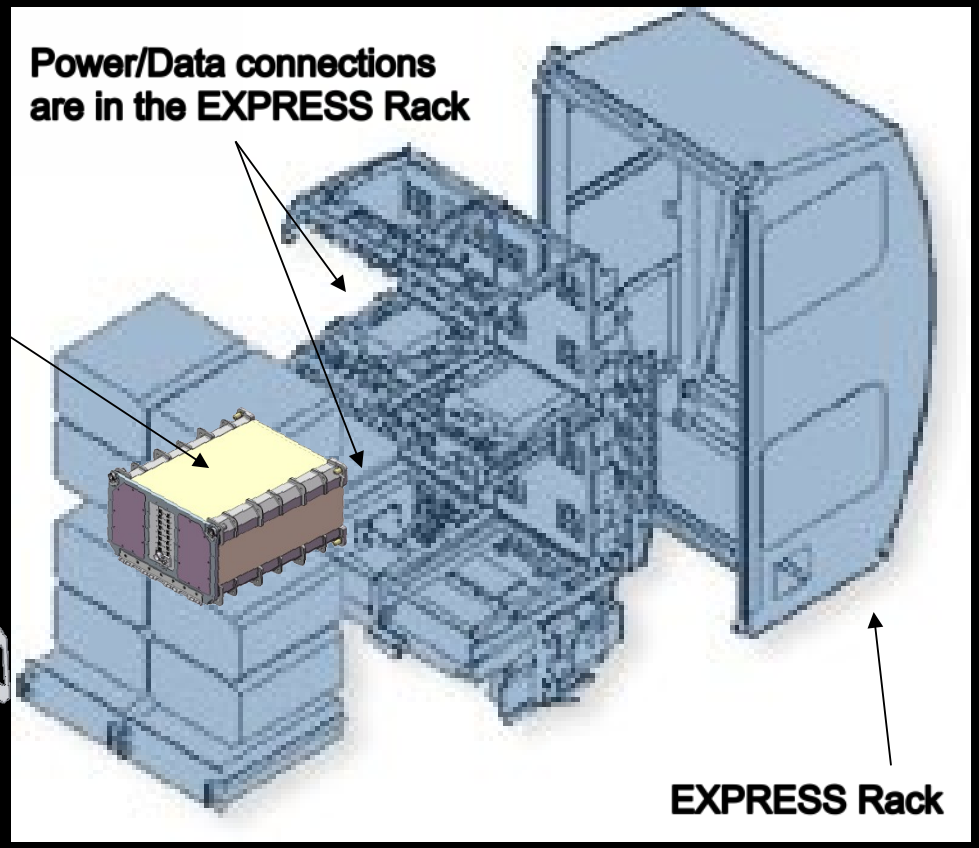
Receive At NanoRacks

ExPRESS RACK OVERVIEW

EXPRESS Rack

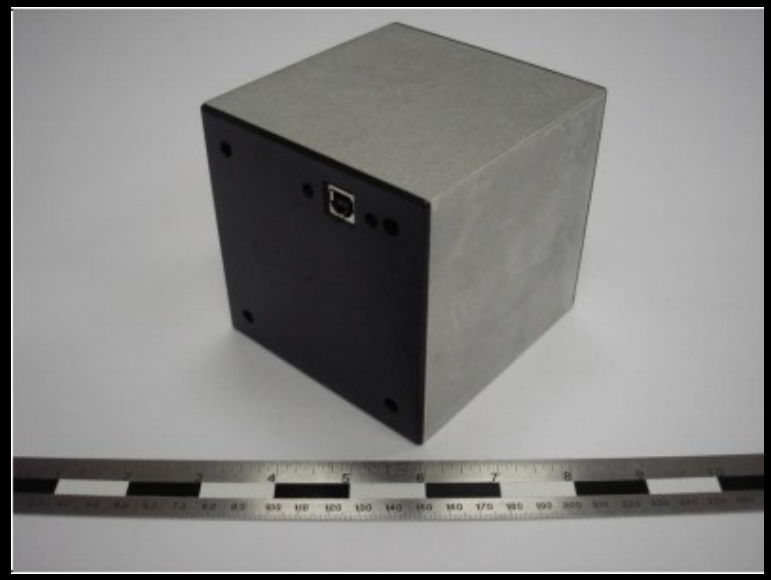
NanoRacks Insert with 16 NanoLabs



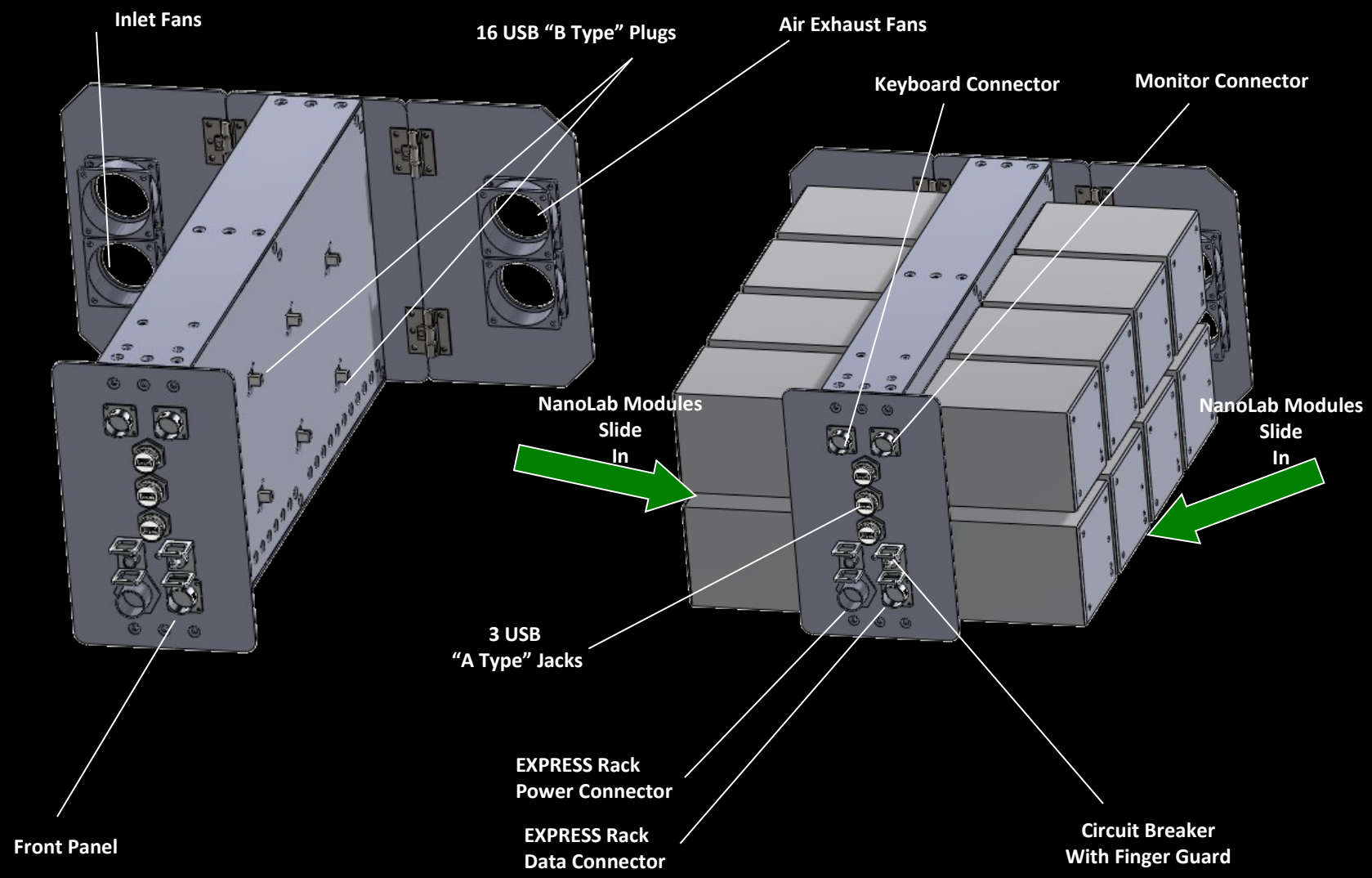


what is a NanoLab?

- A NanoLab is a *Module* that houses a science experiment to be run on the station!
- Interface NanoRacks Platforms 1&2
- Generally 1.5U (10x10x15cm) in size
- Can be as large as 4x2U
- Powered through USB 2.0 5V
- “Plug-n-Play” – plugged in by an astronaut and they’re ready to go!
- Can be operated external to the rack for an additional fee.



NANORACKS PLATFORM 1 / 2 OVERVIEW

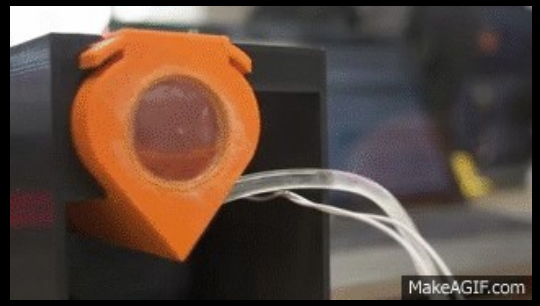


More on “Plug-n-Play” Nanolabs

- Not powered during flight to the ISS
- Standard crew operations are stow/de-stow and power on/off
- USB 2.0 port is flush to Module wall
- No greater than 1kg/U in mass
- No protrusions or sharp edges
- Magnets, batteries, electronics, live science, and other systems are approved on individual bases
- Data Transfer and Down-mass capabilities available

HYDROFUGE PERSONAL PLANT GROWTH CHAMBER

Warren Tech at Lakewood High School, Lakewood Colorado

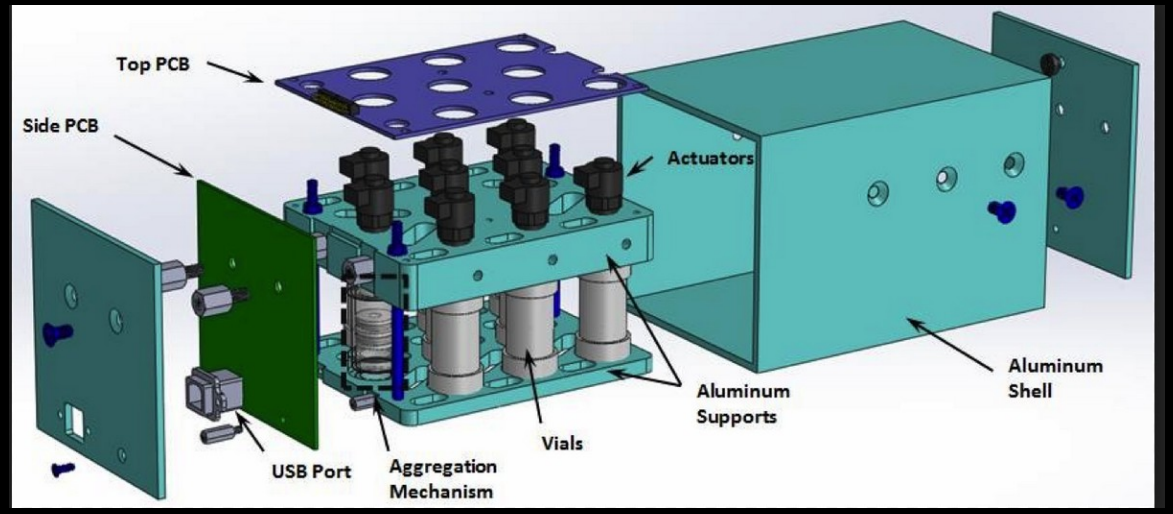


- Renewable food source
- Studies the movement of liquid
- Hopes to conquer the complexity of fluids in microg
- Water tends to smother the roots of plants
- The hydrofuge wicks the water back out
- Uses 80 degrees wetting valve that attracts water
- Lights
- Camera
- Nessi board
- Hopes to keep roots perfectly balanced
- In part uses a translucent 3-d material

SELF ASSEMBLY IN BIOLOGY AND THE ORIGIN OF LIFE (SABOL)

by Florida Institute of Technology

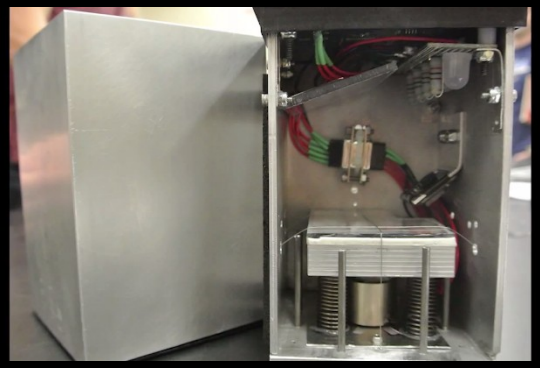
Study of self-organizing processes such as protein aggregation and Amyloid fiber formation greatly benefits from experiments conducted in the weightless environment afforded by the International Space Station (ISS)

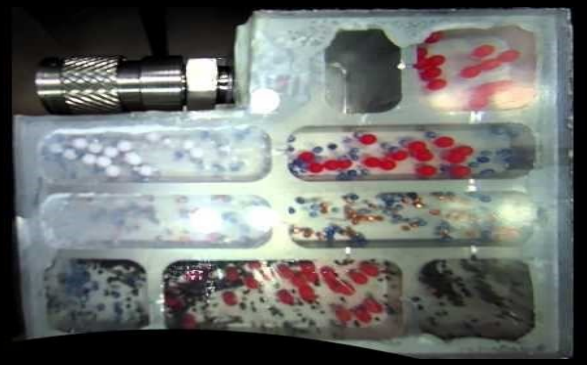


NANOROCKS

by University Central Florida

- Physics project
- Clever Positioning of Camera and mirror
- Springs
- Phase change materials give new data over time
- Usb-powered
- Microcontroller board
- Simulates the formation of how planets and moons formed long ago.
- Study can’t really be replicated anywhere else but microgravity.



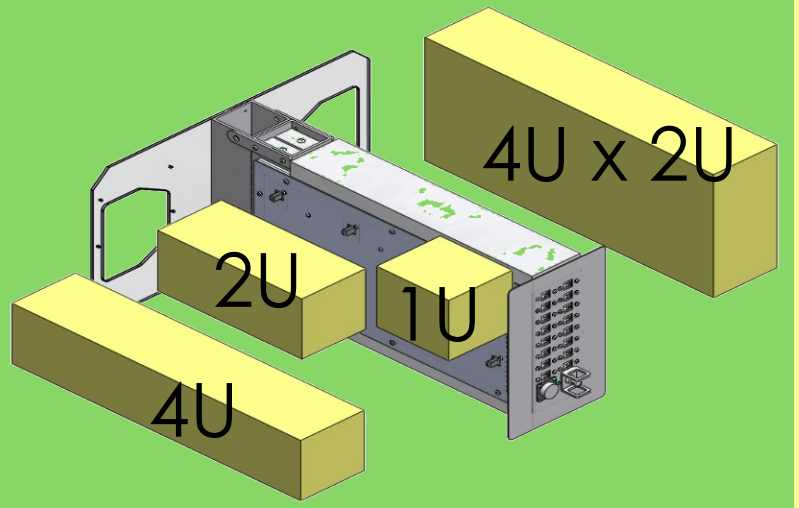


NanoLab Design Process

Step 1: Know your design space

Volume

1U = 10cm x 10cm x 10cm
2U = 20cm x 10cm x 10cm
3U = 30cm x 10cm x 10cm
4U = 40cm x 10cm x 10cm
2x2U = 20cm x 20 cm x 10 cm
2x3U = 20cm x 30cm x 10cm
2x4U = 20cm x 40cm x 10cm



Mass

1U = 1kg
2U = 2kg
Up to
8U = 8kg

Power

1U = 2W max (5VDC, 400mA)
2U = 4W max (5VDC, 800mA)
Up to
8U = 16W max (5VDC, 3.2A)

Data

- Each 1U has a USB Type B female connector that supplies 5VDC, 400 mA and USB data connectivity
- Mission based on 30 days
- Collected data is transferred to a laptop computer in near real time
- Commanding files can be transferred from the ground to laptop to payload

NanoLab Design Process

Step 2: Come up with a payload for your NanoLab

Space Research Areas

Microgravity
- Fluid Science/Fluid Handling
- Soil Mechanics Science
- Metal Solidification/Alloys
- Vapor/Liquid Phase
- Combustion Science
- Life Sciences
- Plant Growth
- Microbiology
- Small animal/insect research
- Crystal Growth
- Protein Crystal Growth
- Astronaut Tools
- Low gravity research

Space Environment
- Radiation measurement
- RF studies
- Magnetic fields

Spacecraft Hardware Qualification
- In-space testing of components
- In-space testing of systems

Keep the Mass Low

Box is aluminum

Limited Crew Interaction

Ambient Temperatures

USB Devices

- Microcontroller
- Flash memory

Sensors
- Camera
- Spectrophotometer
- Microphone
- Accelerometer
- Gyroscope
- Temperature Sensor
- Humidity Sensor
- Air Flow Sensor
- Pressure Sensor
- Capacitance
- RF Sensor
- Resistance
- Magnetic

Actuators
- Magnetic Motor
- Solenoid
- Piezoelectric
- Thermal
- Capacitive
- Speaker
- LEDs/LCDs
- Flag indicators
- Galvanometer
- Valves
- Heater
- Peltier cooler

For further details on the form factor and the dimension options, power requirements, and other details for NanoLabs, please refer to the NanoLab Interface Control Document.

This can be downloaded at:
http://nanoracks.com/wp-content/uploads/Current_edition_of_Interface_Document_for_NanoRacks_Internal_Pla

Are you working on an educational project? www.DreamUp.org , the educational arm of NanoRacks, is your place to get started.

Commercial? Government? Email us at info@nanoracks.com to begin your journey.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