

**LOCKHEED MARTIN**



***FACILITATING NIH RESEARCH  
ON THE ISS NATIONAL LAB***

*June 2009*



**M I S S I O N S U C C E S S**

# NASA Human Research Program Resources



◆ RC (Refrigerated Centrifuge), spins sample tubes from 500-5000 rpm, at ambient temperatures

- ◆ Is capable of running from 1 to 99 minutes, selectable in one minute increments, or running continuously for indefinite run times.
- ◆ Has an impulse button that causes the rotor to spin as long as the impulse button is pressed.
- ◆ Provides selectable speed over a minimum range of 500 to 5000 rpm, selectable in increments of 10 rpm and programmable.
- ◆ Accommodates sample sizes from 0.5 to 50 ml with a maximum of 6 of the 50 ml vials at a time.
- ◆ Two different rotors are available, fixed angle and swinging bucket:



# NASA Human Research Program Resources



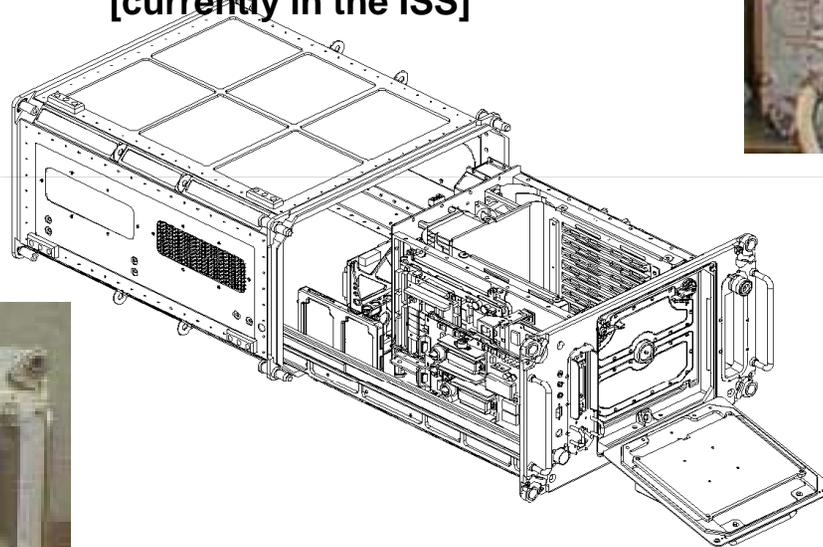
- ◆ **BSTC (Biotechnology Specimen Temperature Controller)** - Incubator: +4°C to 50°C for up to 32 stationary tissue culture modules (TCMs). BSTC was designed to allow multiple experiments studying various types of cells to operate simultaneously. It is a multi-component cell incubator intended to grow three-dimensional clusters of cells in microgravity.
- ◆ **GSM** - Supplies a continuous flow of an air/carbon dioxide mixture to the Biotechnology Specimen Temperature Controller to support and maintain the chemical and physiological processes required to sustain cell cultures.
- ◆ **Biotechnology Cell Science Stowage (BCSS)** - Stowage units designed to safely and efficiently package and transport cellular biotechnology equipment and materials required to conduct experiments onboard the ISS.
- ◆ **Biotechnology Refrigerator (BTR)** - A thermo-electric, temperature-controlled unit which provides 0.53 cubic feet of cold storage at 4 degrees C (39.2 degrees F). Temperature-sensitive cell samples and stowage items were carried in the BTR to the ISS.
- ◆ **Cellular Biotechnology Cryodewar (CBC)** - Can be used to store frozen cell samples until orbit is achieved and the experiments are initiated on the ISS. CBC is a passive device employing absorbed liquid nitrogen as the cryogen.
- ◆ **BTR (Biotechnology Temperature Refrigerator)** - Thermo-electric, temperature-controlled unit which provides 0.53 cubic feet of on-orbit cold storage at 4°C.



# NASA Human Research Program Resources



## Biotechnology Specimen Temperature Controller (BSTC) [currently in the ISS]



BSTC -303 & Locker  
(shown in maintenance position)

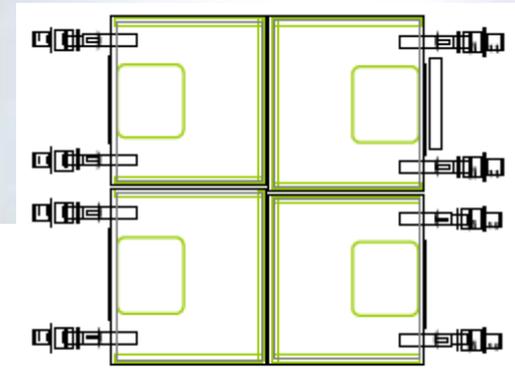
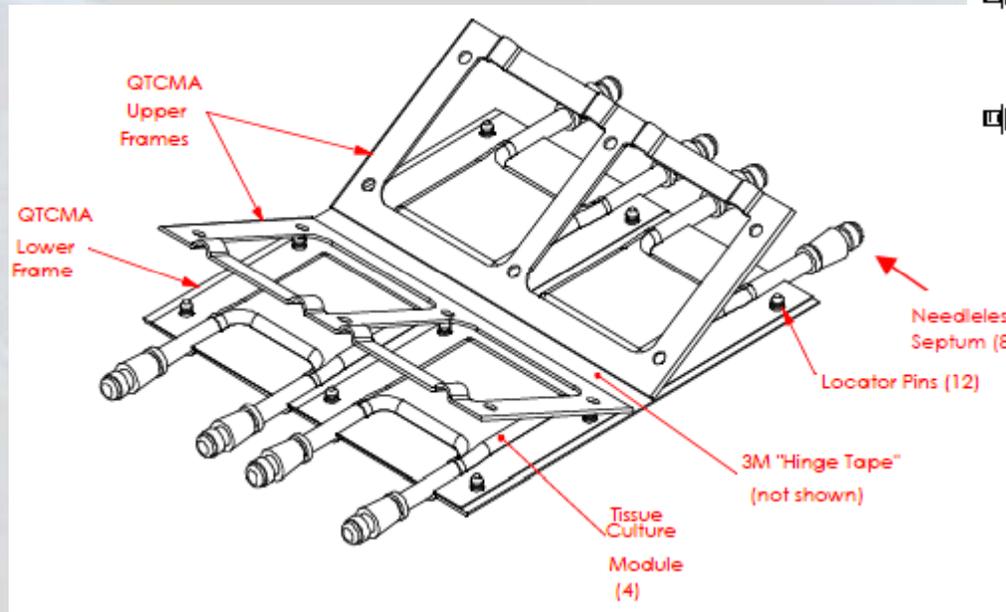


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# NASA Human Research Program Resources



## Tissue Culture Modules (TCMs) in Quad Tissue Culture Module Assembly ( QTCMA)

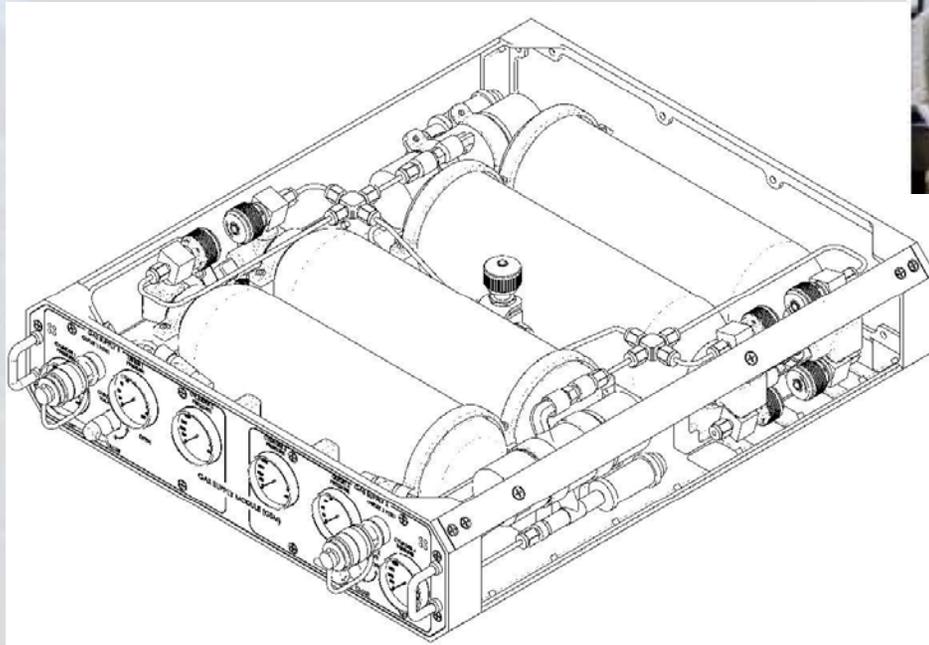


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# *NASA Human Research Program Resources*



## **Gas Supply Module (GSM)** [currently in the ISS]



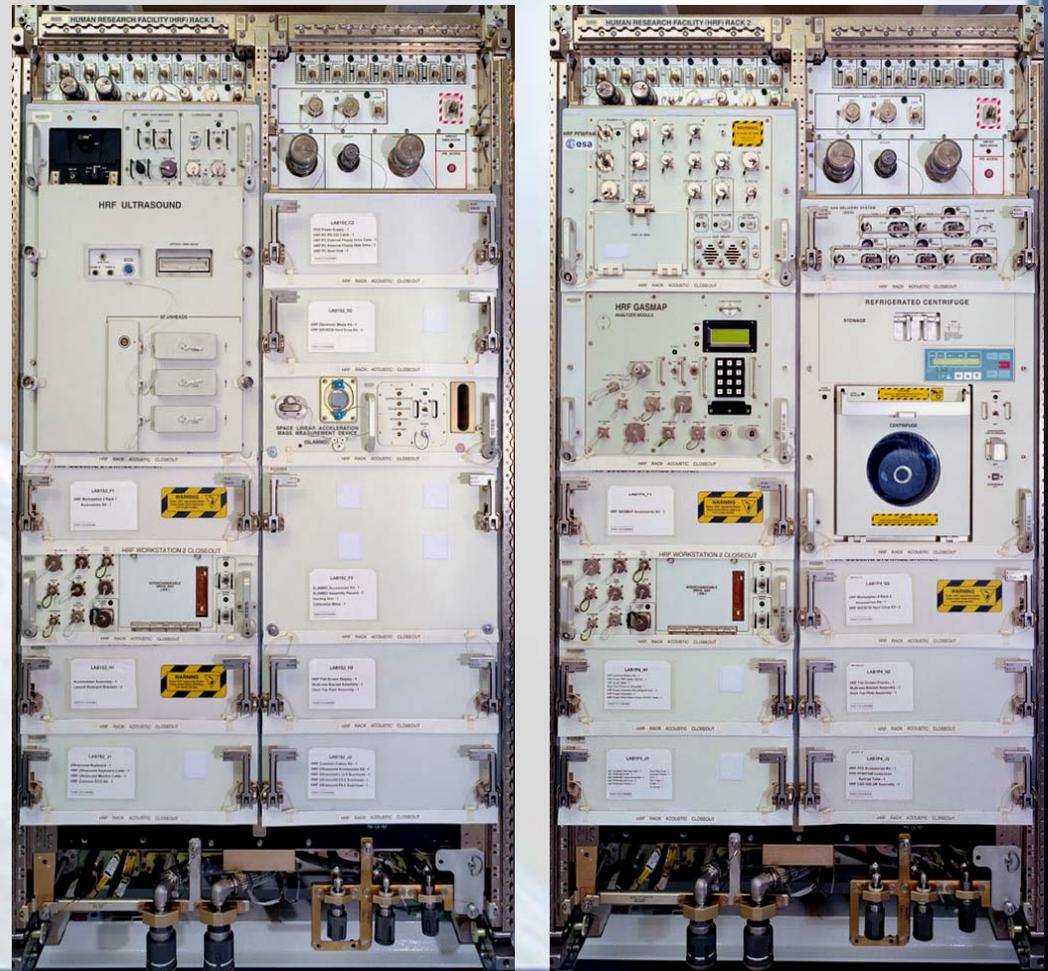
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# NASA Human Research Program Resources



- The Human Research Facility (HRF) is a self-contained on-orbit laboratory. The HRF suite facilitates on-orbit biomedical research in areas such as behavioral health & performance, exercise countermeasures, pharmacology, nutrition, and immunology.
- The HRF Racks combine modularity with innovative data system software to allow for a mix of science instruments that can be easily reconfigured when new capability needs are identified.
- HRF Rack 1, operational in the U.S. Lab since May 2001, includes an **ultrasound imaging system, gas analyzing mass spectrometer, portable computer and workstation for data handling**. HRF Common Software provides an intuitive crew interface and manages the communication path between the racks, ISS, and ground data systems.
- HRF Rack 2, launched on STS-114, added **enhanced pulmonary function, refrigerated centrifugation, and mass measurement capabilities**.

## Human Research Facility (HRF) Racks 1 and 2



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# NASA Human Research Program Resources



## ◆ HRF-1 (Human Research Facility-1)

- ◆ Ultrasound (Clinical Ultrasound Aboard the International Space Station) - ultrasound/Doppler equipment that has both research and diagnostic applications. This equipment provides color, two dimensional analog or digital images that can be downlinked for analysis.
- ◆ SLAMMD (Space Linear Acceleration Mass Measurement Device) for measuring crewmember mass

## ◆ HRF-2 (Human Research Facility-2)

- ◆ CBPD (Continuous Blood Pressure Device)
- ◆ PFS (Pulmonary Function System) includes GASMAP (Gas Analyzer System for Metabolic Analysis Physiology) and PFM/PAM (Photoacoustic Analyzer Module/Pulmonary Function Module), determines the concentration of respired gases, when combined with GASMAP allows a wide range of tests of lung and cardiac function
- ◆ **RC (Refrigerated Centrifuge), spins sample tubes from 1000-5000 rpm, at ambient temperatures**

## ◆ MARES (Muscle Atrophy Research and Exercise System)

- ◆ Measures the strength of isolated muscle groups in arms and legs

## ◆ HRF (Human Research Facility) Common Hardware

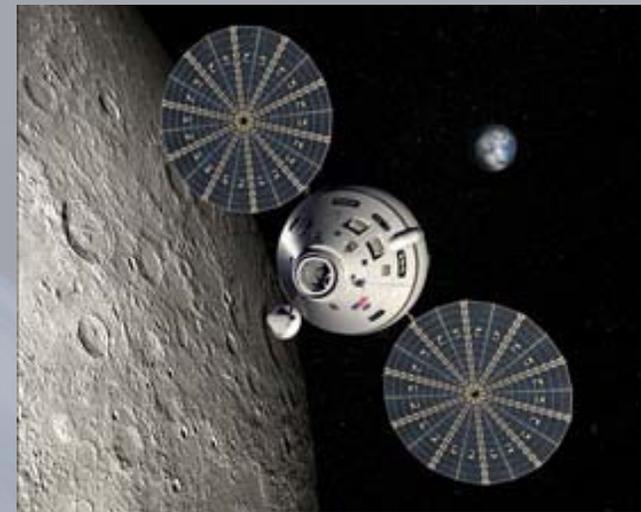
- ◆ Actiwatch measures light exposure and activity
- ◆ Holter Monitor is for electrocardiograms
- ◆ UMS (Urine Monitoring System)
- ◆ PEMS (Percutaneous Electrical Muscle Stimulator)
- ◆ HGD/PFD (Hand Grip Dynamometer/Pinch Force Dynamometer)

# *NASA Human Research Program Resources*



- ◆ Any one interested in utilizing any of the Human Research Program's hardware inventory will need to contact the Human Research Program Office and negotiate a shared resource agreement through that office.
  - ◆ <http://hrp.jsc.nasa.gov/>
  
- ◆ More information on the HRP suite of equipment, including hardware specifications can be found at:
  - ◆ <http://issmp.nasa.gov/>
  - ◆ For the NASA biotechnology hardware, more information can be requested through:
    - ◆ John E. Love, Johnson Space Center, Houston, TX 281-483-7713

# *Lockheed Martin Corporation*



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# Lockheed Martin Services

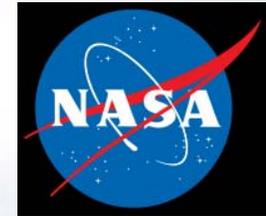


- ◆ Lockheed Martin is also the largest provider of federal technology services in the world.



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# *Lockheed Martin Space and Science Solutions*



- ◆ Lockheed Martin has partnered with NASA and the Johnson Space Center for over 40 years.



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# *Lockheed Martin Space and Science Solutions*

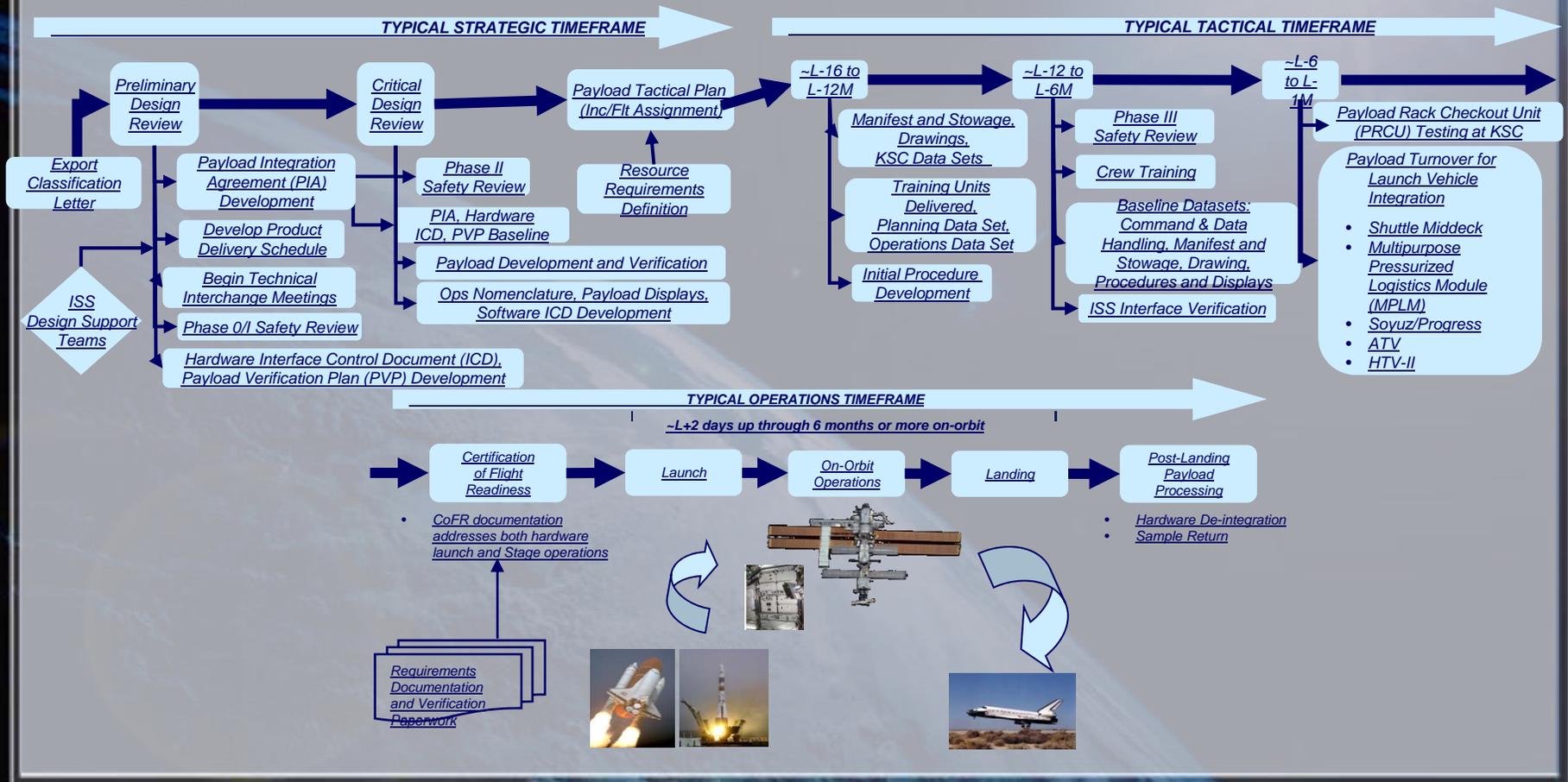


- ◆ As NASA's implementation partner, Lockheed Martin has been executing the flight experiments for NASA's Fundamental Space Biology Program and its Human Research Program since the inception of the International Space Station (ISS).



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# Integration Services for National Laboratory Payloads



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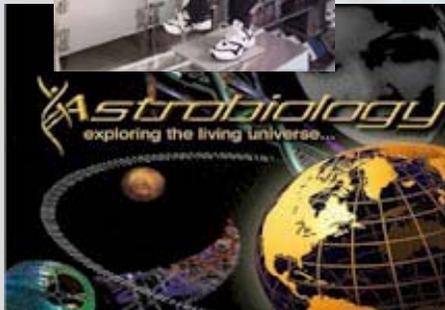
# *Insect Habitats to Space Station Treadmills*



- ◆ Interfaced with hundreds of individual investigators around the world
- ◆ Hands-on experience across a diverse array of biological systems, including cell cultures.
- ◆ Developed a rich understanding of ISS Program payload integration requirements.
- ◆ Honed our internal processes for delivering mission success

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# Science Experiment Integration and Deployment



- ◆ LMSO scientists, engineers, and technicians work with investigators to answer critical questions by bringing cutting edge science and technology to space
  - We support the development, integration and operation of life sciences payloads on the Space Shuttle Middeck, International Space Station, and other free flying space platforms
  - We handle all biological specimen types both at research facilities and at launch site
  - PI support activities include technical interface, biosample and data integrity evaluations, and logistics development and material control
- ◆ Direct Experience Managing Research and Science on the International Space Station
  - ◆ Management throughout the experiment life cycle.
- ◆ Development of Facility-grade Research Hardware
  - ◆ Define, develop, prototype, fabricate, install and test experiment hardware.
  - ◆ Bioinstrumentation to meet research objectives.
  - ◆ Modify commercial-off-the-shelf hardware for flight

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# *Lockheed Martin Space and Science Solutions*



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