NASA Facts

National Aeronautics and
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Lyndon B. Johnson Space Center
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International Space Station

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International Space Station Human Research Facility

The Human Research Facility (HRF) on the International Space Station has two broad research objectives: 1) basic research on humans in microgravity that can be of benefit to solving biomedical problems experienced by people on Earth, and 2) operational research about how humans adapt to microgravity, which can be used to develop improved countermeasures to the negative effects of long-duration space flight.

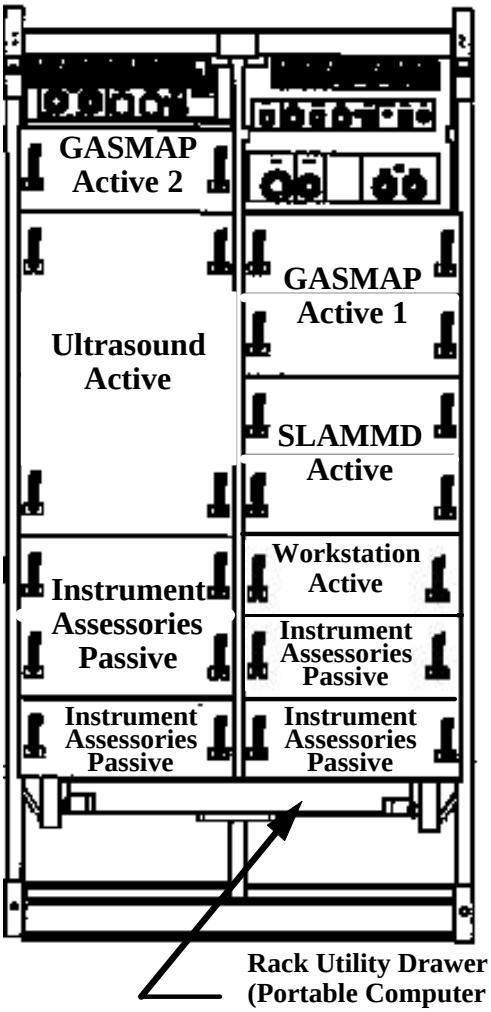
NASA s Johnson Space Center is developing the HRF. With the first HRF rack and associated stowage scheduled for launch in January 2000, the HRF will be the first facility-class payload delivered to the Space Station. The HRF and its associated hardware will be housed in the U.S. Laboratory Module in two Space Station equipment racks.

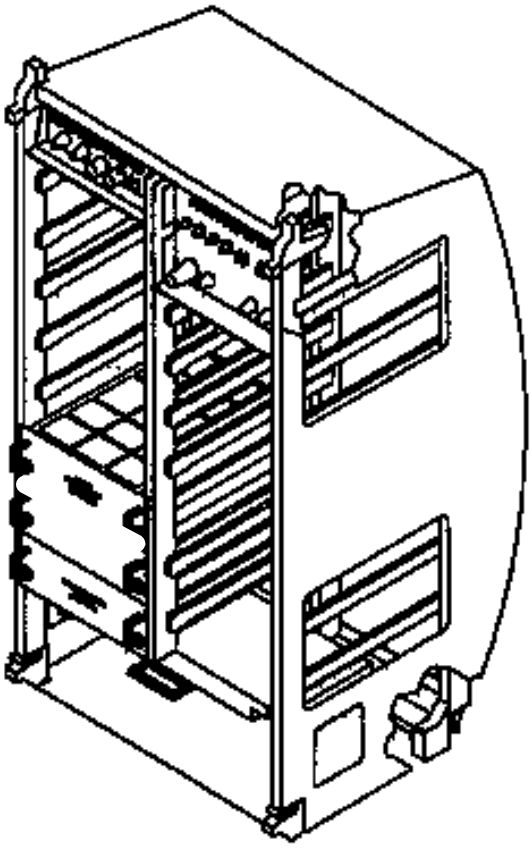
Space research provides unique capabilities to advance our understanding of the heart and lungs (cardiopulmonary research), the growth and maintenance of muscle and bone (musculoskeletal research), the body's ability to sense position and maintain balance (neurovestibular research) and the regulation of the body's many systems (regulatory physiology). The early emphasis of HRF-supported studies will be on research in such areas as exercise function and biomechanics, cardiovascular testing, metabolic studies, behavior, human factors and neuroscience.

The HRF is being designed in a modular fashion to facilitate equipment change-out and to insure maximum science capability. Whenever possible, NASA is using commercially available, off-the-shelf, equipment to reduce the cost of development.

The HRF equipment typically will be contained within standard drawers, which will be accommodated within two equipment racks that provide basic utility and data resource interfaces. Some additional equipment will be mounted outside the rack (in the module aisle) to accommodate human test subjects and a test operator if necessary. HRF stowage and samples also will be located outside the HRF racks in stowage containers and refrigerators/freezers.

First Human Research Facility Rack





HRF dimensions (approximate): 6 feet (2 meters) high by 3 feet (1 meter) wide by 3 feet (1 meter) deep

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Diagnostic equipment will be carried in drawers in the HRF. Some equipment will be prepositioned in 1999. When the first HRF rack is launched in 2000, some items being considered for use are:

- Activity Monitor, a small device worn on the wrist to evaluate quality of sleep, sleep onset and other daily activities.

- Ambulatory Data Acquisition System to provide convenient data acquisition and storage of data collected by physiological sensors. It will measure core

body temperature, blood pressure, respiration and other physiological responses.

- Ultrasound technology to perform sophisticated medical diagnostics aboard the Space Station. These images will be transmitted to Earth so scientists can study the effects of zero gravity on blood flow, the heart and other organs.
- Continuous Blood Pressure Device, a battery-operated instrument that monitors arterial pressure in a finger continuously for up to 24 hours.
- Device to measure the total forces between the foot and a surface.
- Hand Grip Dynamometer to measure hand strength as a function of time.
- Ambulatory electrocardiogram (ECG) to non-invasively measure heart rate over a 24-hour period.
- Lower Body Negative Pressure (LBNP) Device, a cylinder that encloses the lower abdomen and extremities and provides a vacuum sufficient to induce fluid shifts to the lower extremities similar to those imposed by gravity on Earth.
- Gas Analyzer for Metabolic Analysis Physiology (GASMAP), a device to monitor a crew member s inhaled and exhaled breath stream to determine gas concentrations.
- Space Linear Acceleration Mass Measurement Device (SLAMMD) to determine the exact body mass of individual crew members.
- Computer workstation and portable computer.
- Centrifuge to separate biological materials of varying density.
- Other on-board instruments will collect samples of blood, urine, saliva and other body fluids.

Some of the hardware is being provided by international partners. For example, Germany is providing the LBNP device, while the European Space Agency (ESA) will provide the strength measurement device.

Scientists will use results from research supported by the HRF to investigate the critical physiological issues that affect crew health and performance during long-duration stays on the International Space Station. Results from HRF research also will be used to assist in developing and validating counter-measures to alleviate the negative biomedical consequences of long-duration space flight. The research also will be valuable to the medical research community on Earth in studies of osteoporosis, muscle atrophy, hypertension , heart failure and anemia.

An additional major objective of the HRF is to enable data archiving and transfer of scientific data and technology to the extramural science community, to educators and to the public. The HRF data will be collected by direct participation and manipulation by the on-orbit crew. The data are required to be

displayed on-orbit and down-linked, both in real-time and non-real-time. The data include physiological data, environmental conditions, rack system engineering parameters, and digitized and video data.

Additional equipment is under consideration for future use:

- Bone densitometer to non-invasively measure small changes in the density of whole bone
- Core temperature monitor
- Refrigerator/freezer for sample storage
- Head and Body Tracking System to monitor, record and analyze the motion of subjects and to record the performance of experiments on orbit
- Immunization kits
- Skin temperature monitor and skin blood flow monitor
- 3-D eye-tracking/movement monitor to measure eye movements during vestibular and human factors experiments

For further information about life sciences and medical research on the International Space Station, please see page 24 of the International Space Station Research Plan. The complete document may be found on the Internet at http://station.nasa.gov