NASA Facts

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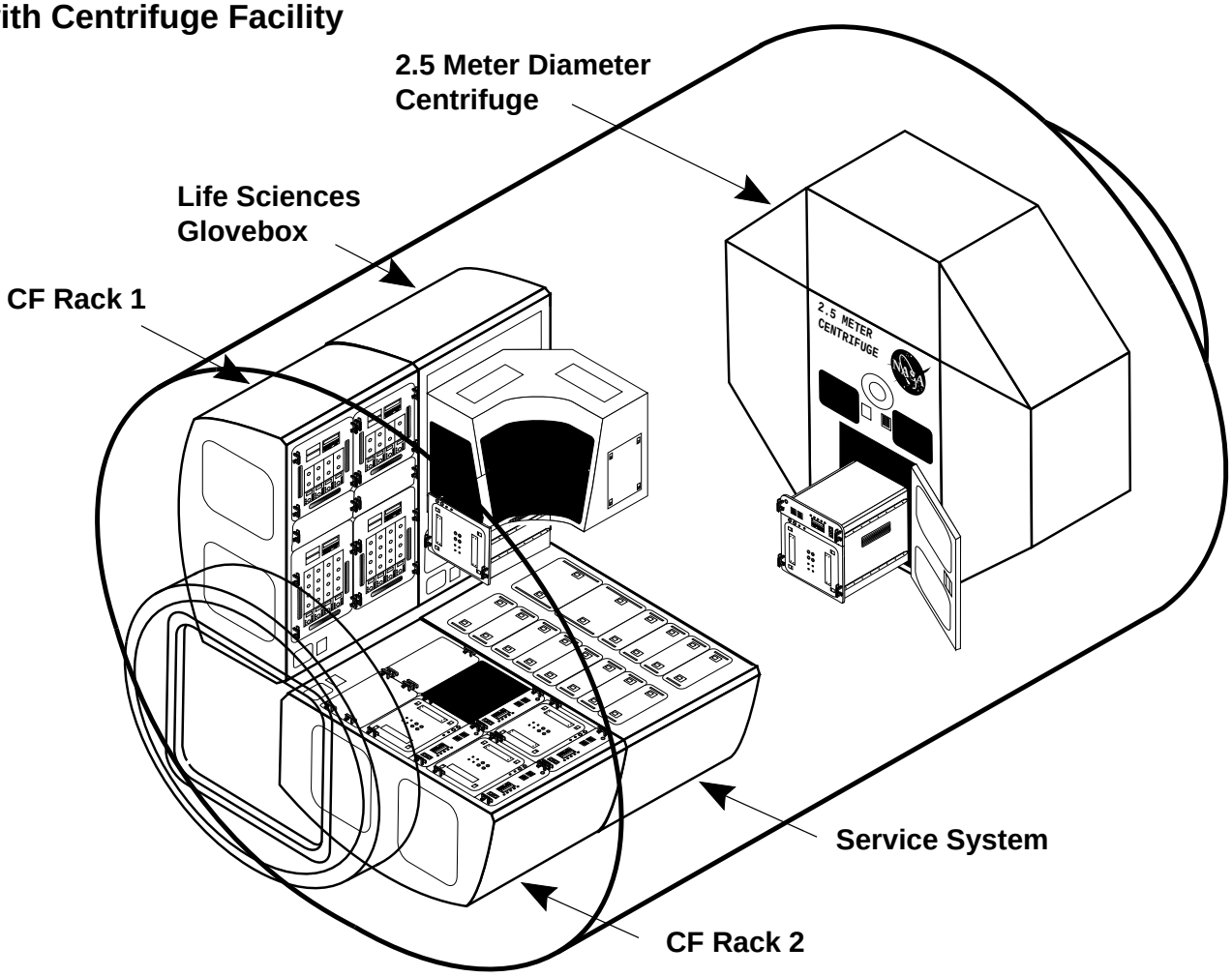
GRAVITATION BIOLOGY FACILITY AND CENTRIFUGE FACILITY ON THE INTERNATIONAL SPACE STATION

The International Space Station will be an orbiting space facility which will include research laboratories and a crew habitation module. NASA and its international partners-the Russian, Japanese, European, and Canadian space agencies-will build and deploy the Space Station beginning in 1997. International crews carried into orbit by the U.S. Space Shuttle and the Russian Soyuz will staff the Space Station on a permanent basis.

Centrifuge Accommodation Module with Centrifuge Facility



Gravitational Biology and Centrifuge Facilities

Two suites of equipment, called the Gravitational Biology Facility (GBF) and the Centrifuge Facility (CF), are being developed for use on the Space Station by the Space Station Biological Research Project at NASA/Ames Research Center in Mountain View, California. These facilities will be used to conduct life sciences research on the effects of gravity, and its absence, on biological systems.

Scientific Objectives

Scientists associated with NASA's space biology program are attempting to understand the role of gravity in the biological processes of lower organisms, plants and animals. This will further our understanding of how organisms are affected by, and adapt to, the space flight environment. The extended-duration studies possible with the Gravitational Biology and Centrifuge Facilities will build on knowledge gained from earlier life sciences missions and will allow scientists to continue investigating these important issues. Researchers will be able to study fundamental processes, such as biological development over successive generations, in the absence of gravity.

A quarter century of space life sciences missions have been conducted by both the American and Russian space agencies, yet much remains to be learned about the role of gravity in biological processes. Previous studies have identified, but not fully explained, the weakening of the cardiovascular and muscular systems, the alteration of blood chemistry, and the bone demineralization that result from exposure to space flight conditions. Continued human exploration of space requires that we understand why these changes occur.

Benefits

In addition to providing insight into the effects of space flight, the data generated by experiments in the Gravitational Biology Facility and the Centrifuge Facility may advance the quality of life here on Earth through applications in agriculture, biotechnology, environmental management, medicine, and other human activities dependent upon biological resources. For example, many diseases affecting humans have symptoms similar to the deconditioning phenomena observed in astronauts and research animals as a result of space flight. A more complete understanding of these phenomena may help scientists develop better treatments for these diseases.

Because the research done in these facilities will increase our understanding of the effects of gravity on biological systems, it will help scientists design countermeasures to offset the effects of long term exposure to zero gravity during space flight, and to partial gravity at future bases on the Moon and Mars. The long operating period and unique capabilities of the Gravitational Biology and Centrifuge Facilities will also help researchers discover how different levels of gravity affect living systems, not only over the course of an organism's life span, but over multiple generations as well. This knowledge will be important if we are to establish permanent human installations in space or on the Moon.

Assembly and Operations

At the end of this century, the first of two Holding Racks containing hardware for the Gravitational Biology Facility will be carried into orbit by the Space Shuttle and incorporated into the U.S. Laboratory Module on the Space Station.

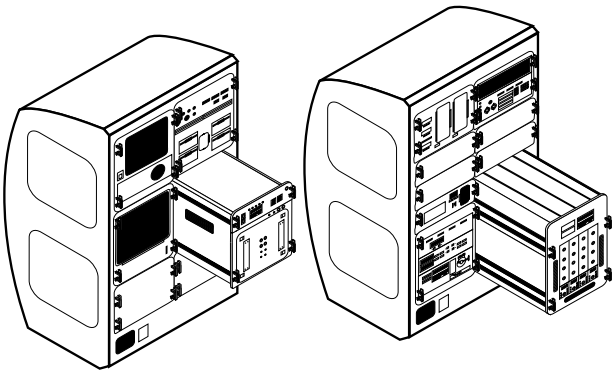
Approximately two years later, the second Holding Rack of the Gravitational Biology Facility, as well as the Life Sciences Glovebox, the Service System, and the first of two Holding Racks for the Centrifuge Facility, will be transported to the Space Station. Shortly after that, the Centrifuge Accommodation Module, containing the 2.5 meter diameter Centrifuge and the second Centrifuge Facility Holding Rack will be brought to orbit by the Space Shuttle and attached to the Space Station. The Centrifuge Facility equipment previously installed in the U.S. Laboratory Module will then be transferred to the Centrifuge Accommodation Module.

Once the scientific equipment is on orbit, the Space Station crew will begin to perform life science experiments. Researchers on the ground will be able to oversee and monitor these experiments through video and data transfer links established between the Space Station and Ames Research Center. From there, experimental data will be relayed to scientists at their institutions and laboratories. Space Shuttle flights to orbit will bring supplies to continue experiments and start new ones, and materiel to replace and upgrade equipment. Return flights will bring experimental samples back to Earth for analyses.

Gravitational Biology Facility Habitats

The Gravitational Biology Facility consists of multiple habitat types to support organisms for research in cell, developmental, and plant biology. These habitats will provide food, water, light, air, and temperature control to the organisms. Each habitat will provide data links to allow monitoring and control of environmental parameters inside the habitats.

Gravitational Biology Facility



GBF Rack 1 **GBF Rack 2**

The Gravitational Biology Facility habitats include a Cell Culture Unit, an Incubator, an Aquatic Habitat, and an Egg Incubator. The Cell Culture Unit will be used to support research in cell and tissue biology. It will have the capability to maintain and monitor microbial, animal, and plant cell and tissue cultures for up to 30 days.The Incubator will also support cell and tissue cultures at selectable temperatures. The Aquatic Habitat will accommodate small fresh water organisms, such as fish, for up to 90 days. It will provide water quality maintenance and food delivery.

A video imaging system will allow scientists to monitor organisms within the Habitat. The Egg Incubator will permit the incubation and development of small reptilian and avian eggs prior to hatching. A small centrifuge within this habitat will provide selectable gravity levels from zero to 1.5-g. Because the Egg Incubator contains its own centrifuge, this habitat will not be used on the 2.5 meter diameter Centrifuge. However, the Aquatic Habitat, the Incubator, and the Cell Culture Unit will be used on the large Centrifuge when selectable gravity is needed for an experiment.

Gravitational Biology and Centrifuge Facility Habitats

Some of the research conducted in the two Facilities will be done using plants and rodents, which will be housed in the Plant Research Unit and Advanced Animal Habitat, respectively. The Plant Research Unit will support plants up to 38 centimeters tall. The Advanced Animal Habitat will house up to six rats or a dozen mice. This Habitat will also use a specialized compartment called a Mouse Development Insert. This Insert will accommodate pregnant mice, and subsequently their offspring from birth through weaning. Both the Plant Research Unit and the Advanced Animal Habitat will be usable on the 2.5 meter diameter Centrifuge.

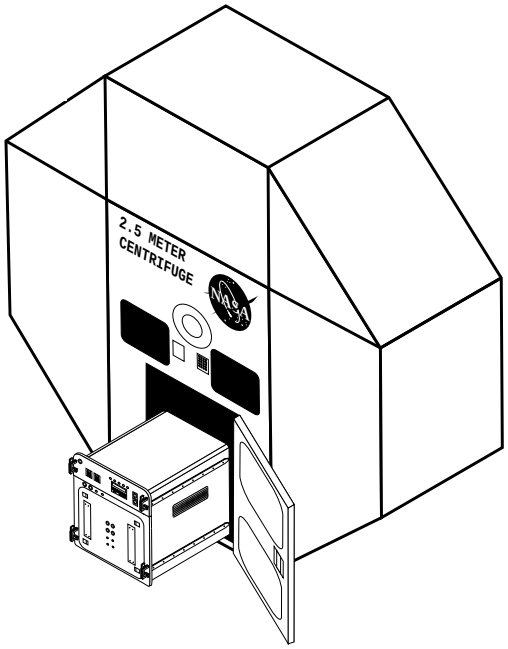
As with the habitats used by the Gravitational Biology Facility, these habitats will provide all necessary life support resources to the organisms. Scientists will be able to visually monitor organisms in the habitat chambers through video cameras. The habitats will also monitor temperature, food and water consumption, and humidity. Additional instrumentation may be needed based on experimental requirements. For instance, in rodent research, devices measuring body temperature, heart rate, blood flow and activity level may be included. All data acquired from the habitats will be available to ground-based researchers.

Gravitational Biology and Centrifuge Facility Holding Racks

During zero gravity experiments the habitats provided by the Gravitational Biology and Centrifuge Facilities will be housed in Holding Racks. Two racks are assigned to each facility, but equipment can be interchanged among the four racks.

Besides habitats, the Gravitational Biology Facility racks will also store the analytical and sample preservation equipment used by life science researchers.

The Holding Racks will provide life support resources and electrical power to the habitats and other scientific equipment, as well as data transfer links to computers on the Space Station. The arrangement of habitats in the racks will be reconfigurable, to allow the removal of equipment that is not being used and the insertion of equipment that is needed for specific experiments.



Centrifuge Facility 2.5 Meter Diameter Centrifuge

The 2.5 meter diameter Centrifuge is sized to support research with larger organisms such as plants and rodents. It will be capable of producing controlled, artificial gravity levels ranging from 0.01-g to 2.0-g. Selectable gravity will permit scientists to compare how

differing gravity levels affect the biology of organisms housed under otherwise identical conditions, thus separating the effects of gravity from other factors in the space environment. This will also allow a comparison between the effects of Earth's gravity and an equal force of artificially produced gravity. This type of experimental comparison is essential if scientists are to understand the effects of gravity on biological systems.

Comparison of living systems exposed to zero gravity to those exposed to the reduced or intermittent gravity levels attainable with the Centrifuge will help determine whether artificial gravity will be necessary during extended human missions into space.

If artificial gravity is necessary, the Centrifuge will help researchers determine how long, and at what level, organisms must be exposed to artificial gravity in order to maintain health. Use of the Centrifuge will aid in the development of effective countermeasures to the effects of space flight evident in astronauts.

Centrifuge Facility Life Sciences Glovebox

Habitats used by both Facilities will attach to the Life Sciences Glovebox, which will provide an enclosed work space used for performing experiments and handling research organisms. Two crew members will be able to use the Glovebox work space at the same time by means of gloves that extend into the work area. The enclosed volume of the Glovebox will be about one-half cubic meter (approximately 18 cubic feet). As air circulates through the work space, activated charcoal filters will continuously clean it by absorbing chemicals that may be present. In addition, a high efficiency air filter will remove particles and aerosols.

Service System

The Service System is essentially an empty rack providing a stored quantity of new habitats, in addition to storage for experimental materials and scientific equipment.

Conclusion

The Gravitational Biology and Centrifuge Facilities, by providing habitats, holding racks, a glovebox, a centrifuge, and a service system, will support advanced, extended-duration space life sciences research aboard the International Space Station.

For further information on the Gravitational Biology and Centrifuge Facilities, please contact:

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