National Aeronautics and Space Administration

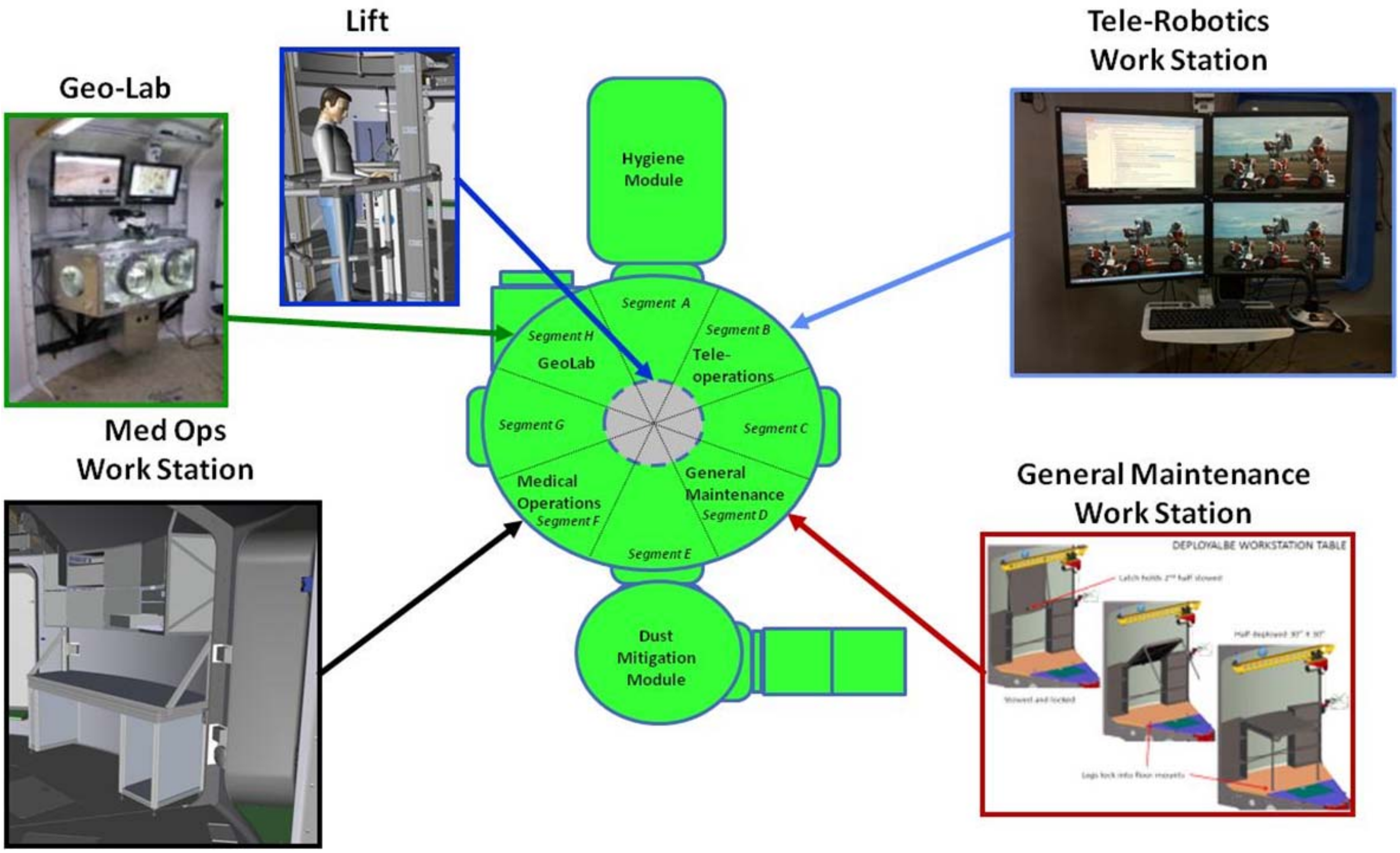
Habitat Demonstration Unit – Deep Space Habitat

NASAfacts

Even in space, there's no place like home

Regardless of what surface they're exploring, at the end of a long day collecting geological samples or performing scientific experiments, astronauts need a base of operations to return to. NASA architects, engineers and scientists are already busy creating exactly that – sustainable, space-based living quarters, workspaces and laboratories for next-generation human spaceflight missions. The knowledge gained from NASA's rich spaceflight history, as well as low Earth orbit projects, such as the International Space Station, is being used in conjunction with Earth-based analog research from the Desert RATS (or Research and Technologies Studies) tests in Arizona to identify and evaluate the most efficient combination of systems, the optimum crew size and best operations conceptions for exploration. NASA can then use the knowledge as we expand our presence to new destinations, like asteroids, near-Earth objects, Lagrange points, the moon, Mars or Mars' moons.

Building a space habitat to maintain good physical and mental health during long-duration space missions is critical to long-term exploration. Incorporating "smart" habitat systems and safety features to mitigate the effects of the hazardous natural environment, supplying adequate air and water, providing waste disposal and recycling, regulating temperature, preserving food supplies and accommodating physical exercise are all issues that must be addressed to allow humans to perform deep space missions.



NASA is preparing for future space travel by developing new intelligent operating systems and hardware. To assess new technologies, NASA has brought together the Habitat Demonstration Unit (HDU) Project to develop habitat configurations for testing and evaluation. The HDU Project provides flexibility in testing and evaluating architectural configurations and mission operations concepts for possible destinations, as defined by NASA's Human Spaceflight Architecture Team. The project employs a multi-center team – led by NASA's Johnson Space Center – that pulls together resources, people and skills to contribute to this unique project.

Testing for space on terra firma

NASA is now testing its second habitat architecture concept – the Habitat Demonstration Unit–Deep Space Habitat, or HDU-DSH. The module will be placed in space-like locations and situations, called analog environments, so that engineers and scientists can test multiple concepts for operations and technologies simultaneously.

Providing a common platform for multiple NASA centers to synergize their technology advances, the DSH allows for the comparison of competitive operations concepts and technologies, and incorporates "green engineering" approaches. Advanced habitation systems tested in the DSH will ultimately be tested in future flight demonstrations.

But first, the HDU-DSH itself will be put through carefully controlled test at the Johnson Space Center, and then in the Arizona desert, where the arid climate, harsh winds and rocky terrain provide a fitting analog for extra-planetary surfaces in the annual Desert-RATS tests.

Featured work stations being tested in the DSH this year include the Geo-Lab (upgraded from the previous version) and the addition of a Tele-Robotics workstation, with which to test control of robotic assets on an asteroid.

Flexible and beneficial

NASA's current plan for exploration calls for a "flexible path" approach, in which humans would visit sites never visited before and extend our knowledge of how to operate in space, while traveling greater and greater distances from Earth. These deep space missions will have less Earth-based support available within real-time communications range and will require a level of crew and mission autonomy greater than has ever been experienced in human spaceflight. This also facilitates the development of many new technologies that could benefit daily life and the environment on Earth, as future space travel destinations are investigated.

NASA is developing advanced "intelligent" habitation systems that will reduce the need for crew and ground control monitoring and maintenance by means of software, controls and embedded smart sensors. This Integrated System Health Management will provide the crew with automated systems capable of self-diagnosis and reconfiguration when it is required. These sensors will also provide resources only when occupants are present, going into quiescent mode when no one is in the habitat, much like “green” buildings here on Earth.

And by implementing intelligent design choices and effective resource management, and by choosing environmentally smart applications, an intelligent building – or habitat – can balance living space, power, resource management and human productivity to maximize its overall efficiency, even after the crew arrives. Mastering these challenges could make dense urban living here on Earth more aesthetically desirable.

In addition, the habitat will be used to evaluate the feasibility of a design approach called logistics-to-living, in which the packaging and logistics systems used to deliver supplies in space are recycled and repurposed into useable elements of the habitat or laboratory, such as furniture, outfitting and partitions. Finding new and innovative ways to recycle can increase the health of our planet and create new industries.

Technologies to support safe and efficient space habitats, with variable environmental conditions, have already been used here on Earth to foster low-carbon footprint, net-zero energy buildings. Some of these technologies are being tested in at NASA’s Ames Research Center as a pathfinder. NASA wants to use these technologies in building new Leadership in Energy and Environmental Design (LEED) certified office buildings at other NASA Centers. This approach to “intelligent” buildings can be used for other government buildings, private industry and homes, greatly reducing operating costs.

Specifications

Non-Flight Shell: Eight composite fiberglass, resin-infused sections from a single mold, supported by large, C-shaped steel ribs

Structure: Cylindrical with a vertically-oriented axis, on top of a 13.8-foot square cradle

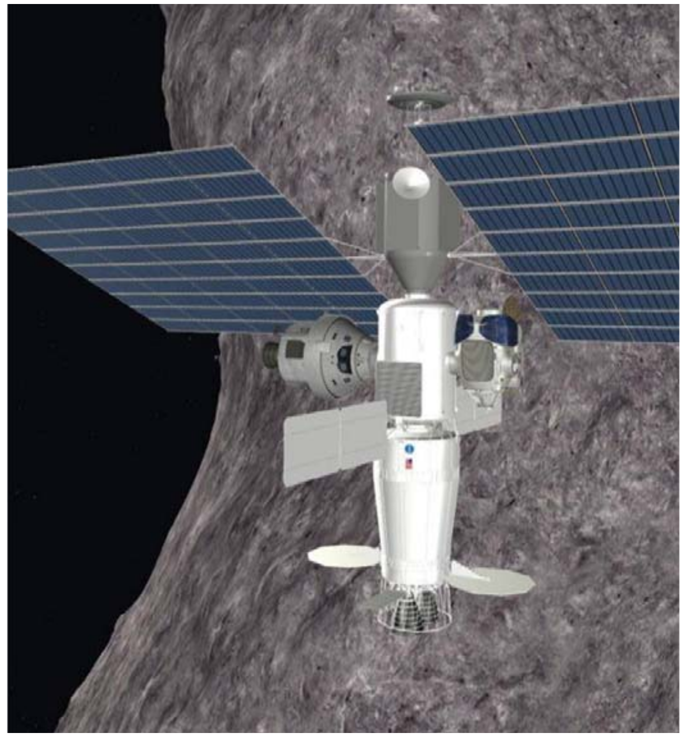
Volume: 5,230.1 cubic feet (148.1 cubic meters) in two levels

Size: 16.4 feet (5 meters) inner diameter; 10.8 feet (3.3 meters) high, total (6.6 feet barrel height with two 2.1-foot end domes on top and bottom)

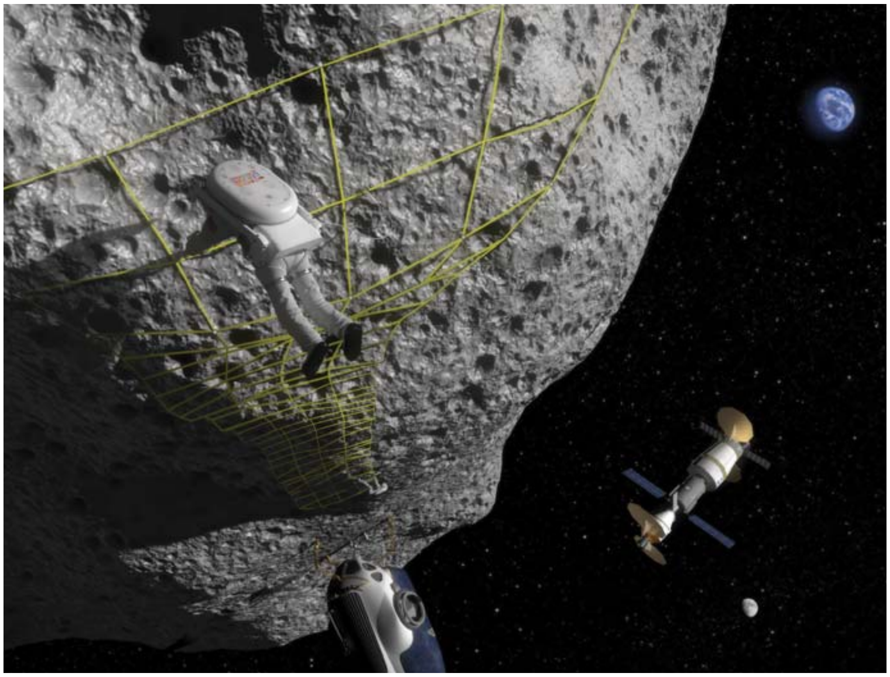
Features: Inflatable loft, two docking ports, one hygiene module and one dust mitigation module/airlock

HDU-DSH Technology to be Tested at D-RATS 2011

NASA must advance the following technologies to become even more efficient, more self-sustaining to support future travel off-planet. Testing conducted in the DSH will move these types of technologies forward, for use on Earth as next-generation “green technology,” as well as in space.



1. Inflatable X-Loft (X-Hab Competition)
2. Tele-Robotics Workstation
3. Logistics-to-Living
4. Autonomous Ops: “Intelligent” Habitat System Management Software
5. iHab Digital Double (D2)
6. Power Generation & PM&D Systems
7. Environmental Protection Technologies
    A. Dust Mitigation Technologies
        a. Electrodynamic Dust
        b. Lotus Coating
        c. Vent Hood Maintenance Workstation
8. HDU Core Computing, Wireless Communication and RFID
9. Standards-based Modular Instrumentation System: Wireless Sensor Nodes
10. Flat Surface Damage Detection system
11. MMOD Hab impact monitoring system
12. General Maintenance/EVA Workstation
13. Medical Ops/Life Science Workstation
14. Geo-Science Lab Glovebox/Workstation
15. Material Handling
16. Food Production: Atrium concept
17. 3-D Layered Damage Detection System for Surfaces
18. Habitability / Habitation
19. Hygiene Module



For online users, click and drag over the graphic below to view the habitat at different angles.

Find the interactive version at http://www.nasa.gov/exploration/analogs/hdu_project.html

National Aeronautics and Space Administration

Lyndon B. Johnson Space Center
Houston, Texas 77058

www.nasa.gov

FS-2011-08-047-JSC