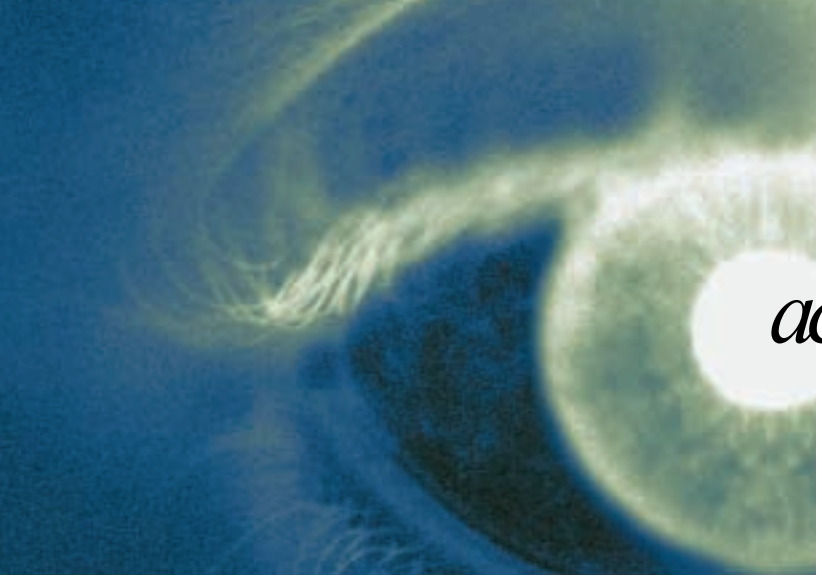


achieving a vision

Space Medicine

SPACE & LIFE SCIENCES

NASA has enjoyed a celebrated role in the history of human space flight. Since the earliest flights our knowledge and capabilities have evolved — and so too have our reasons for venturing beyond Earth. We initially ventured into space to test our technical capabilities, but as our abilities grew, we moved to human space flight, and beyond to exploration of the Moon. Now we are preparing to explore new avenues in the physical and life sciences on a state-of-the-art orbital laboratory, the International Space Station. NASA's Space Medicine program, brings together flight surgeons, biomedical engineers, and researchers in order to take a crucial step in the evolution of human space flight. The Space Medicine program enables us to better understand the limits and potentials of human activity in the space flight environment and identifies how we can best ensure the health, performance, and safety of our astronauts. The Space and Life Sciences Directorate at NASA's Johnson Space Center in Houston, Texas leads the Space Medicine program, contributing to the Human Exploration and Development of Space (HEDS) enterprise. This brochure is one in a series that explores NASA's multilateral activities in the space and life sciences.

Right, STS-50: Commander Richard (Dick) Richards and payload commander Bonnie Dunbar are taking a break from their United States Microgravity Laboratory responsibilities. While microgravity means moving, eating, and sleeping in new ways, it also means that many of the body's systems are adversely affected by space flight. Although significant, these changes are mostly short-term adaptations that allow the human body to function more efficiently in space. Doctors and scientists in the Space Medicine program are specifically concerned with how changes could jeopardize the health and safety of astronauts and what countermeasures are needed to ensure their well-being. NASA's Biomedical Research and Countermeasures program is responsible for developing ways to deal with these changes (for more information, see the Biomedical Research and Countermeasures brochure in this series).

The Space Medicine program has responsibilities that span every step of astronauts' careers, from selection into the astronaut corps and medical exams first approving them for space flight, to long-term studies into the effects of space flight that continue long after a flight is over. In addition, Space Medicine personnel provide occupational health support for NASA employees, medical support for human research and training, and operational support for missions. In order to fulfill these wide-ranging duties, the program must integrate comprehensive healthcare with cutting-edge technologies while meeting the physiological demands placed on astronauts during space flight. Although NASA's Space Medicine program conducts all of these activities concurrently, we will investigate its roles before, during, and after a mission for the purpose of best understanding the program's different functions.

NASA's Space Medicine program certifies that astronaut candidates are healthy enough for space flight when they enter the astronaut corps and before each space flight mission.

DIRECTORATE

before flight

The Space Medicine program draws upon considerable experience in human space flight to ensure the health, performance, and safety of astronauts before they embark on their orbital journey. Space flight presents a rigorous challenge to even well-conditioned human bodies and minds. Astronauts not only experience biological changes throughout their bodies (including the heart, lungs, brain, muscles, and bones), but they must simultaneously manage the stress of living and working in a confined environment away from friends and family. The Space Medicine program supplies an on-orbit health care system that will addresses these changes and challenges.

Space Medicine personnel reduce the human health risk associated with space flight through safety protocols, pre-flight astronaut health exams, and rigorous training exercises. Despite such precautions, health complications may still occur as a result of illness, injury, or on-orbit crew activities. To confront this possibility, flight surgeons prepare specially designed supplies, medicine, and equipment to be kept on board and train the crew in medical procedures.

All crew members are trained in first-aid procedures, including CPR, while two crew members receive more intensive training. This training teaches the crew members to administer treatments for the kinds of common medical issues that could arise during the mission.

Getting Down to Earth

Virtual reality technologies used to train astronauts in preparation for their mission are also a valuable tool for physicians on Earth. Physicians can now prepare for surgical procedures with the "virtual scalpel" seen at right. This physician is practicing a reconstructive surgery on the skull.

once on orbit

Once a human space flight mission is launched, the vehicle becomes a closed self-sufficient system far from Earth. While the Space Medicine program is still accountable for crew health and safety from the ground, on-board capabilities — equipment that monitors the environment, food, and water — assume a greater role in the program's responsibilities.

During the first week in space, an astronaut's adaptation to the microgravity environment requires careful monitoring. For astronauts who spend months at a time in space, proper nutrition, regular exercise, stress management, and psychological support require increasing attention from flight surgeons.

Scientists and doctors in the Space Medicine program have developed small, non-intrusive, user-friendly medical equipment for the unique task of administering health care in microgravity. One example of this is the Telemedicine Instrumentation Pack (seen here). This briefcase-sized device includes diagnostic tools usually found in a doctor's office (such as a stethoscope, blood pressure cuff, EKG, and pulse oximeter) as well as advanced communications technologies that allow for transfer of the medical data back to Earth.

To meet the challenges of these missions, the Space Medicine program advances the state of the art by providing innovative solutions to the real-time medical needs of astronauts. One area where NASA's Space Medicine program has been on the cutting edge is in the development of miniaturized and wireless communication technologies for collecting and sending complex data and images — and the incorporation of this technology into virtual reality applications.

The Space Medicine program also provides medical support to astronauts on orbit through a team of qualified flight surgeons on the ground. Daily conferences between astronauts and their designated physicians build trust and open lines of communication that help to identify health concerns before they deteriorate into problems. These conferences with flight surgeons offer psychological support to astronauts learning to live and work in microgravity and encourage the scheduling of free time and other stress-management activities.

Getting Down to Earth

Not only have advancements in the combination of medical care and communications technologies, called telemedicine, brought enormous benefit to astronaut health care, but they also have numerous applications here on Earth. Telemedicine solutions have served patients in nearly all the remote regions of the Earth. People in the jungles of Brazil, on boats in the middle of the ocean, on climbs on Mount Everest, and on the farms of South Dakota benefit from telemedicine capabilities. Telemedicine also has applications for emergency situations such as disaster relief efforts and military deployments.

With this combination of on-orbit monitoring and ground-based care, the Space Medicine program has consistently met the many challenges of human space flight. As we move towards possible future trips to the Moon, Mars, and beyond, missions will require increasingly self-sufficient medical systems capable of overcoming time (delays up to 40 minutes for communications to and from Mars) and distance.

after a mission

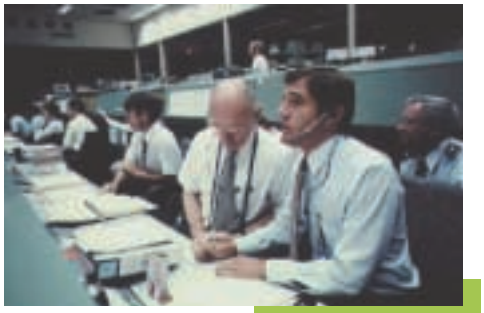
Although the astronauts have returned safely to Earth, the responsibilities of the Space Medicine program do not end at landing. Follow-up medical exams are very important. The scientists and doctors in the Space Medicine program compare an astronaut's post-flight exams, questionnaires, and samples with those taken before

and during the mission to better understand the changes that occur during space flight, on what timeline they occur, and how effective countermeasures have been in preventing adverse responses to life in microgravity.

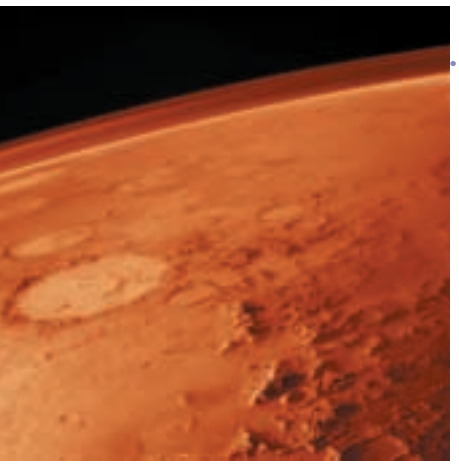
Getting Down to Earth

Like any population living in close quarters, astronauts on orbit may be at increased risk for disease or illness. NASA has sponsored research to better understand vector-borne diseases. One way scientists are doing this is by combining satellite images (like the one seen here) with ground-based data to identify areas at high risk for the spread of disease. Through studies on the spread of illnesses such as cholera, Lyme disease, and malaria, NASA scientists have gained a greater understanding of how to protect astronauts' contageous diseases, while contributing to our understanding of epidemiology here on Earth.

The data generated from these tests is compiled in the Space Medicine program illness and disease pattern database, which in turn is used to enhance pre-flight screening, training, on-orbit medical support, and post-flight examinations. Additional information is compiled in order to assess other indicators of astronaut health and safety: radiation exposure limits, the contaminant and toxin environment, and the quality of emergency medical services. Likewise, this information flows into the Biomedical Research and Countermeasures program, which uses this improved understanding of the astronauts' responses to space flight in order to develop more effective countermeasures. In sum, these databases and resultant advances in the capabilities of the Space Medicine program contribute to the continued ability to protect the health, performance, and safety of our astronauts.

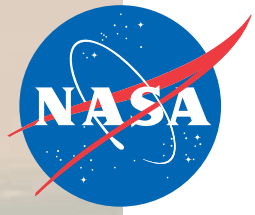


Flight surgeons conduct their daily communications with astronauts and assess their health status.



conclusion

With each human space flight mission NASA's Space Medicine program learns valuable lessons, allowing Space Medicine personnel to better prepare astronauts for their missions, integrate life support hardware more fully, and enhance the quality of in-flight medical support. As our space program evolves from shuttle missions, to permanent human habitation in Earth's orbit, to exploration of the Moon, Mars, and beyond, the work of the Space Medicine program will enhance the quality of life on Earth while advancing our goal of space exploration.



contact information

Johnson Space Center - homepage
http://www.jsc.nasa.gov/

The Office of Life and Microgravity Sciences and Applications - homepage
http://www.hq.nasa.gov/office/olmsa/

Biomedical Research and Countermeasures Program - homepage
http://www.hq.nasa.gov/office/olmsa/lifesci/biomed.htm

NASA Human Spaceflight
http://spaceflight.nasa.gov

International Space Station - science and research
http://spaceflight.nasa.gov/station/science/index.html

The International Space Station - *Research Plan* online
http://www.hq.nasa.gov/office/olmsa/ISS/cover.htm

National Space Biomedical Research Institute - homepage
http://www.nsbri.org/

Life Sciences Data Archive
http://lsda.jsc.nasa.gov

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