National Aeronautics and Space Administration

NASAfacts

# Analog Missions and Field Tests

NASA is actively planning to expand the frontier of human space exploration beyond low Earth orbit to destinations farther into the solar system than humans have ever gone before.

The Space Launch System and the Orion Multi-Purpose Crew Vehicle will transport humans to these deep-space destinations. To reduce risk to astronauts and prepare them for work once they reach their destination, technologies and concepts must be developed and tested here on Earth.

One of the ways NASA tests mission concepts and technologies is by conducting analog missions on Earth. Analog missions are field tests conducted in locations that are identified based on their physical similarities to the extreme space environments of a target mission. NASA engineers and scientists work with representatives from other government agencies, academia and industry to gather requirements and develop the technologies necessary to ensure an efficient, effective and sustainable future for human space exploration.

NASA's Apollo program successfully conducted analog missions to develop mission activities, surface transportation and science operations. Today, analog missions are conducted to validate architecture concepts, demonstrate technologies and gain a deeper understanding of system-wide technical and operational challenges. These analog missions test robotics, vehicles, habitats, communication systems, in-situ resource utilization (ISRU) and human performance as it relates to human space exploration.

## Extreme Environments

NASA has not yet confirmed the technologies that will be used in future space exploration missions, but with the successful testing of systems and procedures in simulated and extreme environments on Earth and the International Space Station, humans move one step closer to a sustainable human presence in space.

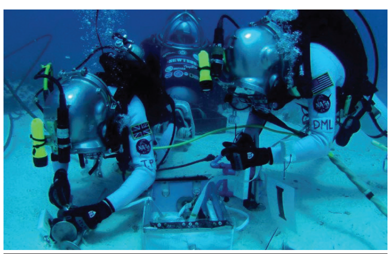
## Research and Technology Studies (RATS)
*Environment: Desert & Virtual Simulation Faciliites*

*RATS 2012 crew member Trevor Graff pilots the prototype second-generation space exploration vehicle integrated with the Virtual Reality Laboratory.*

NASA's Research and Technology Studies (RATS) team evaluates technology, human-robotic systems and extravehicular equipment. Prototype hardware and systems provide a knowledge base that helps scientists and engineers design, build and operate better equipment and establish requirements for human spaceflight operations and procedures.

Some examples of technologies the RATS team has evaluated include space-suit equipment, robots, habitation modules, exploration vehicles, surface mapping and navigation techniques and power and communication systems. NASA has conducted RATS testing in Arizona, California, Washington and in the Space Vehicle Mockup Facility and other laboratories at the agency's Johnson Space Center in Houston.

## NASA's Extreme Environment Mission Operations (NEEMO) *Environment: Ocean*



*Two astronauts simulate installation of a geophysicial array on an asteroid, with one secured to a portable foot restraint carried by a mini sub, and the other wearing a jetpack.*

One of the most extreme environments on Earth is the ocean. The NASA Extreme Environment Mission Operations project, known as NEEMO, sends groups of astronauts, engineers and scientists to live in the world's only undersea laboratory, the National Oceanic and Atmospheric Administration's (NOAA) Aquarius Reef Base, located 63 feet beneath the ocean's surface in the Florida Keys.

Similar in size to the International Space Station's living quarters, Aquarius provides NEEMO crew members, called aquanauts, with an experience that has many parallels to the challenges of living in space. Aquanauts are exposed to real hazards, including isolation, cramped living quarters, communication delays and weightlessness during undersea "spacewalks."

Two-week missions provide aquanauts an opportunity to simulate living in a spacecraft while testing advanced navigation and communication equipment, robotics and vehicles. These tests cultivate an astronaut's understanding of daily mission operations and create realistic scenarios for crews to make real-time decisions.

## In-situ Resource Utilization Demonstrations (ISRU) *Environment: Volcanic*

*NASA and its international partners test equipment on a cold, remote volcano during field tests in Hawaii.*

The rock distribution and soil composition of Hawaii's volcanic deposits provide an ideal terrain for testing ISRU hardware and operations. ISRU is a process that harnesses local resources for use in human and robotic exploration.

NASA conducts this analog mission in collaboration with partners including the Pacific International Space Center for Exploration Systems and the Canadian Space Agency. Together they demonstrate ISRU hardware that characterizes and extracts compounds like water and carbon dioxide from the volcanic remains. The same technology could be used to look for water ice in lunar or other planetary environments.

## International Space Station Testbed for Analog Research (ISTAR) *Environment: Low Earth Orbit*

*Assembly of the International Space Station was complete in 2011. It has been continuously inhabited for more than 10 years, and is the cornerstone of future human space exploration.*

The International Space Station (ISS) offers a unique platform to test future exploration systems and operations because it provides a long-duration, zero-gravity space environment and the opportunity to evaluate many factors not available in other analog missions.

NASA will use the ISS as a test site for long-duration missions to identify the risks and challenges to astronaut health and safety, prepare for crew autonomous operations needed for handling communication time delays, exercise ground elements training and technology development, and evaluate new exploration systems and capabilities as they become available.

ISTAR will challenge the astronauts to work progressively longer periods unassisted by mission control–just as would be expected on a mission to Mars or a near Earth asteroid. Future ISTAR missions could last as long as six months and would use ISS confinement and zero-gravity to simulate crew activities during long-duration flights and crew arrival at an exploration destination.

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