



# Exploration Systems Development

Over the next decade, NASA will practice deep space operations with decreasing reliance on Earth, gaining the experience and systems necessary to make pioneering deep space and the journey to Mars a reality.

NASA's Exploration Systems Development programs are building the crew vehicle, rocket, and spaceport of the future that will enable the agency's bold new missions to extend human existence beyond the moon, to an asteroid, Mars, and across the solar system.

The early missions for Orion and the Space Launch System (SLS) will be the first of many missions that will travel more than 40,000 miles beyond the moon to an area of space that is only a few days away from Earth, yet farther than the Apollo astronauts traveled. The vicinity of the moon serves as a great area to gain experience with deep space operations and also as a staging area from which we can send future missions to Mars. We are referring to this area of space as the proving ground.

## The Orion Crewed Spacecraft

For the first time in a generation, NASA is building a human spacecraft that will usher in a new era of space exploration. NASA's Orion is designed to support human exploration missions to multiple destinations in deep space. Named after one of the most prominent constellations in the night sky and building upon more than 50 years of spaceflight research and development, Orion will meet the evolving needs of our nation's deep space exploration program for decades to come. Its versatile design will allow it to safely carry and sustain a crew on a series of increasingly challenging missions. It will be the safest, most advanced spacecraft ever built, and will serve as the exploration vehicle that will carry the crew to space, provide emergency abort capability, sustain astronauts during missions, and provide safe re-entry from deep space return velocities.

## The Space Launch System Rocket

SLS is the world's most powerful rocket and will launch astronauts in the agency's Orion spacecraft on missions to deep space, while opening new possibilities for other payloads including robotic scientific missions to places such as Mars, Saturn, and Jupiter.

Offering the highest-ever payload mass and volume capability and energy to speed missions through space, SLS is designed to be flexible and evolvable, to meet a variety of crew and cargo mission needs.

In 2015, NASA completed the critical design review—a first for a NASA exploration class vehicle since Apollo—and continues to move forward with production of the launch vehicle. Engineers are making rapid progress toward delivering the first SLS rocket to NASA's Kennedy Space Center in Florida for its first launch. Flight hardware is currently in production for every element.

NASAfacts



## The Multi-User Spaceport at Kennedy Space Center

NASA's Kennedy Space Center is America's gateway to other worlds. This is where NASA will launch SLS and Orion into the proving ground to test its deep space capabilities and prepare to send humans to the Red Planet.

The Ground Systems Development and Operations team continues to modernize the legendary NASA center into a multi-user, 21st-century spaceport with future capabilities to launch new vehicles in development by both NASA and its commercial partners.

Teams at Kennedy Space Center are making progress on facilities including the Vehicle Assembly Building, Launch Control Center, Multi-Payload Processing Facility, crawler, Pad B modifications and Mobile Launcher upgrades. The ground systems team continues to upgrade its processes, facilities, and ground support equipment to safely handle rockets and spacecraft during assembly, transport, and launch. The teams are working hard to be ready to support future vehicle processing and launch operations including the first mission with Orion atop the SLS in late 2018.

### Exploration Mission-1 (Uncrewed)

Exploration Mission-1 will be the first integrated mission of NASA's Orion spacecraft and Space Launch System rocket lifting off from the historic NASA launch site at Kennedy Space Center's Pad 39B that supported shuttle missions for three decades. The 70-ton evolvable SLS will send an uncrewed Orion thousands of miles

beyond the moon. Orion will ultimately splash down about 25 days after launch off the coast of California. EM-1 will test SLS's launch performance, Orion's ability to operate in deep space and return home safely, and deep-space navigation and communication systems. This heralding achievement will prove the agency's commitment and capability to extend human existence into deep space and is a critical step on the journey to Mars.

### Exploration Mission-2 (Crewed)

The first crewed mission of Orion and SLS will focus on checking out the mission and crew systems and demonstrating the capability for astronauts to operate this vehicle in the proving ground extending just beyond Earth's orbit before returning safely to Earth. As the second proving ground mission, EM-2 will keep the crew in space for up to two weeks and test technology that will help develop habitation capabilities as well as explore multiple stable staging orbits for future deep space missions.

### Future Missions

Beyond EM-2, NASA is considering a wide range of activities that not only demonstrate the ability to live and work in deep space, but also accomplish a suite of proving ground objectives and validate key operational capabilities required to become Earth independent. While SLS and Orion flight rates will ultimately be determined by available funding and mission requirements, NASA is working toward flying at least one crewed mission per year.



National Aeronautics and Space Administration

#### Headquarters

300 E Street, SW  
Washington, DC 20546  
[www.nasa.gov/centers/hq](http://www.nasa.gov/centers/hq)

[www.nasa.gov](http://www.nasa.gov)

NF-2016-04-601-HQ