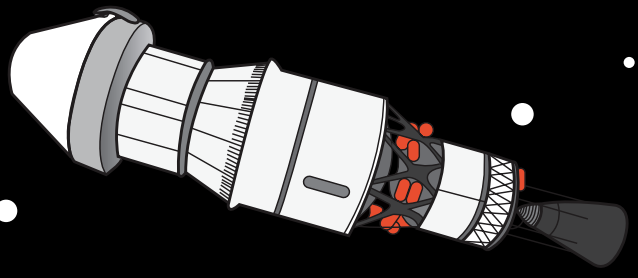
LAUNCHING ORION *into Space*



Learn about the tremendous effort put forth by thousands of people across the country to launch Orion into orbit, and the challenges that will be faced as Orion is prepared for flight.

Orion has been designed with the minimal mass and maximum capability needed to safely transport everything needed for four crew members to live and work in space for up to 21 days.

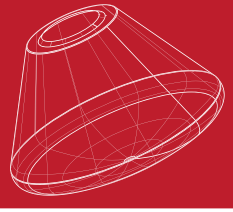
Flight tests are difficult and complex but are necessary for engineers to gain confidence that the systems critical to crew safety will work during space flight.

There are thousands of steps that must be carried out sequentially – or even simultaneously – and function in perfect harmony for a seamless launch.

Separation events that are critical during Orion's first few minutes of spaceflight are very dynamic, requiring the close attention of the entire flight team.

THE JOURNEY TO THE LAUNCH PAD

DESIGNING ORION



AN ENGINEER'S MAGNUM OPUS

PUTTING ORION TO THE TEST

RIGOROUS TESTING PRIOR TO FLIGHT

LAUNCHING ORION

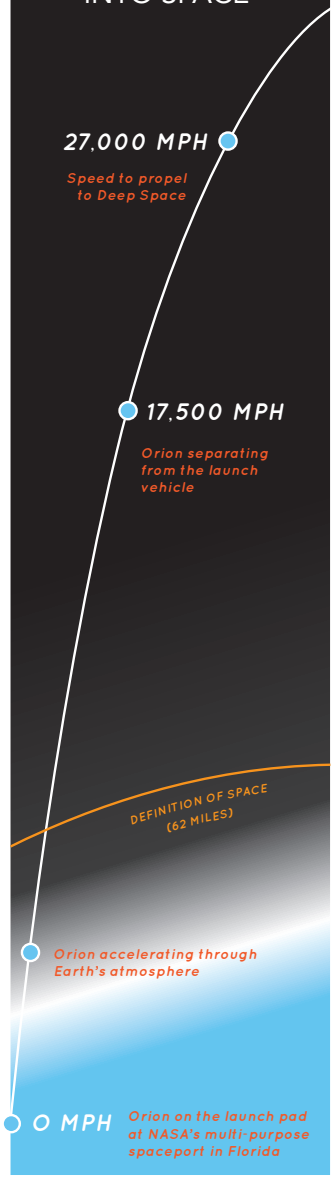
SENDING ORION THROUGH THE ATMOSPHERE

OVERCOMING EARTH'S GRAVITY

PUSHING ORION INTO DEEP SPACE

ACHIEVING SUCCESS

LAUNCHING ORION INTO SPACE



Challenges of Spaceflight: Launching Orion into Space

Orion is America's next-generation spacecraft. It will carry astronauts to deep-space destinations, never before explored by humans. The first step of getting Orion from Earth's surface and into space is no small task, however.

Launching a crewed spacecraft on a path for deep-space exploration will require NASA's Space Launch System – a rocket that stands taller than the Statue of Liberty and fires more than 8.4 million pounds of thrust, equal to 135 powerful Boeing 747 jet engines.

In addition, before Orion lifts off of the ground there are many tests and preparations that must be completed to prepare and certify Orion for flight. Launching Orion on an exploration mission takes a tremendous effort put forth by thousands of people across the country.

THE JOURNEY TO THE LAUNCH PAD

Designing Orion: An Engineer's Magnum Opus

Building a versatile spacecraft like Orion for human missions beyond low-Earth orbit requires a vehicle that is lightweight yet robust, and innovative enough to handle the harsh environments of space. Orion has been designed with the minimal mass and maximum capability needed to safely transport everything needed for four crew members to live and work in space for up to 21 days. Mass is a key driver in spacecraft design, because more mass requires more energy to launch. Higher energy requirements for launches mean your spacecraft needs more robust launch vehicles and more robust safety systems. With more than 20 miles of wires and harnesses, sophisticated avionics and life-saving safety systems, Orion's intricate network of cabling, harnesses and tubing, balanced with mass requirements, is an engineering work of art.

Putting Orion to the Test

The Orion spacecraft is comprised of the crew module, where astronauts will live and work during the mission; the launch abort system, which propels the crew module to safety in the event of an emergency; and the service module, which provides energy and life support to the crew module, as well as in-space propulsion. All of these components are put through rigorous testing prior to flight to support the overall development of the spacecraft.

The launch abort system was successfully tested in May 2010 on a test flight called Pad Abort-1. The three-motor, solid-rocket system propelled a test version of the Orion crew module off the launch pad, racing from 0 to 500mph in a matter of seconds. Orion flew a mile up and a mile downrange to a safe distance from the simulated danger, landing gently in the desert of White Sands Missile Range only 90-seconds later.

Flight tests are difficult and complex, but necessary for engineers to gain confidence that the systems critical to crew safety will work during spaceflight. Without flight tests, the data analysts use to refine designs and computer models would be incomplete.

LAUNCHING ORION: A carefully choreographed dance into space

During any rocket launch, there are thousands of steps that must be carried out sequentially – or even simultaneously – and function in perfect harmony for a seamless performance.

Shake, Rattle, and Roll Through the Atmosphere

To leave Earth, Orion must defy Earth's gravity and battle Earth's atmosphere as it climbs to orbit. During the ascent into space, the onboard software takes command to fly the vehicle. This complex software system guides the vehicle through the acceleration of launch as it battles the atmosphere and structural loads. The computers running the software on Orion have the ability to handle 480 million instructions per second – more than the average math teacher will issue in a lifetime!

Spaceflight Stage Fright

On Orion's way to orbit, there are a series of events that must occur to separate the spacecraft from the excess weight of equipment necessary for launch. Three massive panels, called fairings, protect the service module and give structural support to the crew module and launch abort system on the ride into space. But neither the protection nor the support is needed for long, and rather than let the weight slow it down for the rest of the mission, the panels are released six minutes into flight. Similarly, the launch abort system would only be used on the launch pad or during the early stages of ascent. Seconds after the service module fairings go, the launch abort tower follows them, allowing the exposed crew and service modules to continue on their journey.

The launch abort system is a key reason that Orion is intended to become the safest spacecraft ever built. In an emergency it could activate to pull the crew module and the astronauts it will carry away from the launch pad and the rocket in milliseconds. Hopefully it's never needed, and since no crew will fly on Exploration Flight Test-1, the rescue system won't be active.

But even when a launch goes perfectly, the 904-pound launch abort system jettison motor has to perform flawlessly. If it doesn't get rid of the launch abort system 6 minutes and 20 seconds into the mission, there will be no landing – the launch abort system protects the crew module during ascent, but to do so, it blocks the parachutes that allow Orion to safely splashdown.

The launch abort system separation is just the first of 17 separations or jettisons that have to happen exactly as planned for the mission to be successful.