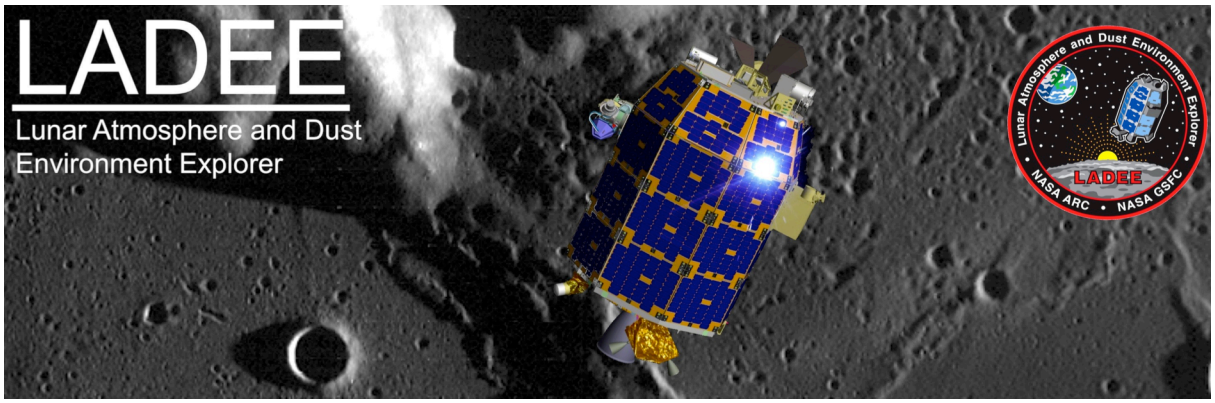


NASA's Lunar Atmosphere and Dust Environment Explorer (LADEE) is a robotic mission that will orbit the moon to gather detailed information about the lunar atmosphere, conditions near the surface and environmental influences on lunar dust. A thorough understanding of these characteristics will address long-standing unknowns, and help scientists understand other planetary bodies as well.

The Moon Has an Atmosphere?

Yes! The moon's atmosphere is much thinner than the atmosphere we have on Earth; the lunar atmosphere is thought to be only 1/100,000th the density of Earth's. At sea level, Earth's atmosphere contains about 100 billion air molecules per cubic centimeter. Scientists theorize on the surface of the moon, there are only about 100,000 to 10 million molecules per cubic centimeter. That still sounds like a lot, but it's definitely not enough air for humans to breathe and the lunar atmosphere actually is considered a vacuum. The thickness of the atmosphere at the moon's surface is comparable to the outer fringes of Earth's atmosphere, where the International Space Station orbits. The moon's atmosphere, technically a surface bounded exosphere in which the atoms and molecules do not collide with one another, but only with the surface of the planet, is an example of a type of atmosphere we may encounter on small planetary bodies throughout the solar system.

While we know Earth's atmosphere has oxygen, we do not know what comprises the moon's atmosphere. To help us understand what it contains, LADEE will dip into the lunar atmosphere and instruments onboard the spacecraft will send detailed measurements to scientists to analyze on Earth.

What Is Dust Like on the Moon?

The Apollo astronauts who explored the moon found its surface covered with a fine dust made from crushed lunar rocks. This powdery dust is the result of billions of years of meteor impacts that also created the moon's cratered surface we see today. Scientists believe electric charges build up at the boundary where the "daytime" (or light) and "nighttime" (or dark) sides of the moon meet. These charges could possibly lift dust from the surface high into the moon's atmosphere. LADEE will help to unravel the Apollo mystery by measuring the extent to which dust is lofted into the lunar atmosphere.

The LADEE Spacecraft

In the past, spacecraft have been custom designed and built – almost like a unique piece of jewelry. The centerpiece of a spacecraft is its payload – a collection of science instruments or technology demonstrations that will help it fulfill its mission. Just as most jewelry has parts designed to be used together – like clasps, chains, and connectors – spacecraft also have common components.

The Modular Common Spacecraft Bus, or body, is an innovative way of transitioning away from custom designs and toward multi-use designs and assembly-line production, which could drastically reduce the cost of spacecraft development, just as the Ford Model T did for automobiles.

The current common bus design has the ability to perform on various kinds of missions - including voyages to the moon and Near Earth Objects - with different modules, or applicable plug-and-play systems.

For example, a common bus used for a mission to land on a planetary body could add a module for "legs" and other associated components. For an orbiter, engineers could insert a body extension. And for a more compact mission, they could take out the extension to make the spacecraft lighter and decrease launch costs.

Launch

LADEE's launch in 2013 will mark several firsts. It will be the first payload to launch on a U.S. Air Force Minotaur V rocket integrated by Orbital Sciences Corp., and the first deep space mission to launch from NASA's Goddard Space Flight Center's Wallops Flight Facility in Virginia.

The Minotaur V is a five-stage version of the Minotaur IV. It is designed to provide launches for small missions requiring geosynchronous transfer or translunar orbits.

Wallops, located on Virginia's eastern shore, was established in 1945 by the National Advisory Committee for Aeronautics. The oldest continuous rocket launch range in the United States, Wallops is a national resource for aerospace-based science and technology research using suborbital and orbital vehicles.

LADEE's Science Instruments

LADEE has three science instruments and one technology demonstration onboard.

Ultraviolet and Visible Light Spectrometer

Will determine the composition of the lunar atmosphere by analyzing light signatures of materials it finds. The Principal Investigator is Anthony Colaprete, NASA's Ames Research Center, Moffett Field, Calif.

Neutral Mass Spectrometer

Will measure variations in the lunar atmosphere over multiple lunar orbits with the moon in different space environments. The Principal Investigator is Paul Mahaffy, NASA's Goddard Space Flight Center, Greenbelt, Md.

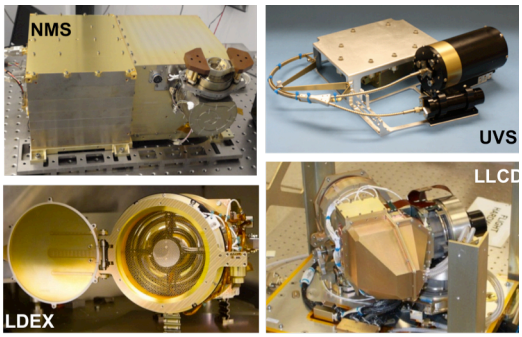
Lunar Dust Experiment

Will collect and analyze samples of any lunar dust particles in the tenuous atmosphere. These measurements will help scientists address a long-standing mystery: was lunar dust, electrically charged by solar ultraviolet light, responsible for the pre-sunrise horizon glow that the Apollo astronauts saw? The Principal Investigator is Mihaly Horanyi, Laboratory for Atmospheric and Space Physics, University of Colorado at Boulder.

Technology Demonstration

Lunar Laser Communications Demonstration

Currently, communications with spacecraft beyond close Earth orbits require spacecraft to have small, low-mass, low-power radio transmitters and giant satellite dishes on Earth to receive their messages. However, the LADEE spacecraft will demonstrate the use of lasers instead of radio waves to achieve broadband speeds to communicate with Earth.



LADEE's payload consists of three science instruments and a technology demonstration.

NASA's Science Mission Directorate in Washington funds the LADEE mission, a cooperative effort led by NASA's Ames Research Center, Moffett Field, Calif. Ames is responsible for managing the mission, building the spacecraft and performing mission operations. NASA's Goddard Space Flight Center, Greenbelt, Md., is responsible for managing the science instruments and technology demonstration payload, and the science operations center. NASA Wallops Flight Facility will be responsible for launch vehicle integration, launch services, and launch range operations. NASA's Marshall Space Flight Center, Huntsville, Ala., manages LADEE within the Lunar Quest Program Office.

For more information about LADEE, visit: **www.nasa.gov/ladee**