



Lunar CRater Observation and Sensing Satellite

The LCROSS Instruments

The Lunar Crater Observation and Sensing Spacecraft called LCROSS is a NASA mission that will help us learn about the Moon and will provide information needed for establishing a human presence on the Moon. The scientific goal of LCROSS is to determine if there is water ice on the permanently shadowed regions of the Moon's poles. When the 2,300 kg¹ upper stage of the Centaur rocket, which carried LCROSS to the Moon, hits the surface traveling at 5,600 miles per hour, it will create a substantial cloud or plume of ejecta² many miles high.

Scientists hope the impact will eject material containing water from the lunar surface. Nine instruments onboard the LCROSS spacecraft will collect data to determine how much water is contained in this material and establish what form the water takes.



Photo courtesy NASA/Ames and Brian Day

Two Near Infrared³ Spectrometers⁴ will examine the plume for evidence of water vapor⁵ water ice, and hydrated minerals. One Near Infrared Spectrometer will be pointed down toward the impact site and one will look out horizontally as the LCROSS spacecraft flies through the plume created by the Centaur rocket impact.

If there are indeed water-bearing materials carried up into the plume, the intense energy of the Sun will break apart some of the water molecules. The Visible Light Spectrometer will look for signs of byproducts of water molecules breaking apart, which provides evidence of the water they came from.

The Mid Infrared⁶ Cameras will image the heat energy given off by the lunar surface before and after the impact and examine the material freshly exposed by the impact and the blanket of material that falls back down to the surface. These cameras will help researchers understand how the temperature of the plume changes with time, because this also reveals the water content of the plume.

The Visible Light and Near Infrared Cameras will confirm the exact location of the impact and allow scientists to study the size, shape, and structure of the impact plume. Using cameras in both the visible and near infrared region of the electromagnetic spectrum reveals information that may not be clear in only one wavelength. Information in the near infrared region of the spectrum will also be used to generate water concentration maps.

The Total Visible Luminance Photometer⁷ will be used to look for the flash⁸ generated from heat as the Centaur rocket hits the lunar surface. The impact will release energy, vaporizing⁹ material in both the Centaur rocket and on the lunar surface, creating a brief visible flash of thermal energy. The photometer will measure the total brightness of the flash and how quickly it builds and then decays. The way in which the light brightens and then fades will tell scientists about what they hit on the lunar surface and how the impact took place.

Although the LCROSS instruments will be able to detect water concentrations in the ejected material as small as 0.1%, ground based measurements from telescopes on Earth will be most effective at detecting water in the plume **immediately** after the impact.

1: kg - One kg is the standard unit of mass in the International System (SI) of units. 2: Ejecta - ejected matter, such as matter from an erupting volcano. 3: Near Infrared - the shortest wavelengths of the infrared region of the electromagnetic spectrum, which are closest to visible light and about the size of cells. Wavelengths roughly from 0.75 to 2 microns. 4: Spectrometers - an instrument designed to separate electromagnetic radiation into its component frequencies. 5: Vapor - the gaseous state of a substance that is liquid or solid under normal conditions, water ice, and hydrated [chemically combined with water] minerals. 6: Mid Infrared - the wavelengths of infrared radiation which lie between the far infrared closest to the microwave region of the spectrum and the near infrared closest to visible light. Wavelengths from roughly 3 to 8 microns. 7: Luminance Photometer - an instrument for measuring a property of light, especially luminous intensity or brightness. 8: Flash - to give off light or be lighted in a sudden burst. 9: Vaporizing - causing a substance to become in a gaseous state rather than liquid or solid under normal conditions.

