

**ASTRONOMY BEHIND THE HEADLINES**  
A podcast for Informal Science Educators  
from the **Astronomical Society of the Pacific**  
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**Episode 3: WATER ON THE MOON**

with **Brian Day**, Education & Public Outreach Lead for NASA's LCROSS mission

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**HOST:** Welcome to Astronomy Behind the Headlines, a podcast by the Astronomical Society of the Pacific. In the not too distant future, humans will return to the Moon to explore and live on its surface. Eventually, they'll train there for future missions to Mars and other worlds of the solar system. To do all this, those future lunar inhabitants will need safe habitats and plenty of water. As it turns out, the Moon may have all the water we need, locked away in ice deposits at its poles. That ice was first hinted at in data from the Clementine and Lunar Prospector missions that investigated the Moon in the 1990s.

Today, NASA's Lunar Reconnaissance Orbiter, nicknamed LRO — and the Lunar Crater Observation and Sensing Satellite — called LCROSS — are allowing scientists to search for water at the lunar south pole. Brian Day is the education and public outreach lead for the LCROSS mission. We talked with him about this water-hunting expedition. Brian, how will LCROSS help scientists find water on the Moon?

**BRIAN DAY:** Well, the LCROSS mission is actually going to use the Centaur upper stage of our moon rocket as an impactor. We will be directing that Centaur into one of the permanently shadowed craters at the south pole of the Moon, and

it will excavate several hundred tons of material, raising it out of the shadows, and flinging it some ten kilometers high into the lunar sky.

These permanently shadowed craters are particularly interesting to us because many of these have remained isolated from sunlight for over a billion years. So, if you're looking for a place where water ice could accumulate over time, these permanently shadowed craters are certainly the place to look.

**HOST:** So, how much water do you estimate is locked away at the lunar South pole?

**BRIAN DAY:** Well, the honest answer to that is, we don't know. You can make some back-of-the-envelope calculations. So, we know that there's about 12,500 square kilometers of permanently shadowed terrain on the surface of the Moon. And, if you figure the top meter of that contains as much as 1 percent by mass of water, then you'd end up with something on the order of  $4 \times 10^{11}$  liters of water. So, there could be a significant resource there.

**HOST:** Now, there's been speculation that a lot of the ice at the lunar poles comes from comets that impacted the surface of the Moon. Let's talk about that.

**BRIAN DAY:** That's a good point. We think a lot of this material could come from comets or related bodies called carbonaceous chondrites.

And these could deliver water to the Moon, but they could also deliver hydrocarbons — complex organic molecules — sometimes as complex as even amino acids.

So, it's interesting to think that perhaps these bodies not only delivered to the Moon, but delivered to the Earth, some of the materials that are absolutely essential to life — not only water, but perhaps even the building blocks of life.

**HOST:** Recently, we heard about LCROSS finding evidence of water on Earth. Tell us about that.

**BRIAN DAY:** Ah yes. So, on August 1st, LCROSS performed its first Earth look in which it pointed its instrumentation toward the Earth for calibration purposes. Earth is a target we're pretty familiar with. And, the instrumentation successfully detected a number of spectral signatures, including water, ozone, methane, carbon dioxide — and, of course — oxygen.

Some of the more subtle features might possibly even correspond to vegetation on the surface of the Earth.

So, all in all, the Earth look was very successful, and we were very gratified to see the instrument payload performing very well.

**HOST:** Are you going to have it take another look at Earth?

**BRIAN DAY:** We are definitely talking about having another Earth look during the course of our transit to the Moon.

**HOST:** Do you have a target date for the impact set yet?

**BRIAN DAY:** Yes, so the impact is going to occur on the morning of October 9th. That's 11:30 Universal Time. Here on the Pacific coast, it ends up being 4:30 in the morning Pacific Daylight Time, so we're planning on a nice early day that day.

**HOST:** During the LCROSS mission's impact in October, astronomers everywhere will be watching for a plume of material blasted out when the probe

hits the Moon. If YOU have access to a good-sized telescope, YOU might be able to see it, too.

You'll find more information about water on the Moon, and the current lunar missions — including LRO and LCROSS — at the Astronomical Society of the Pacific's Astronomy Behind the Headlines website: [www.astrosociety.org/abh](http://www.astrosociety.org/abh). Thank you for listening!

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Special thanks to Brian Day and Dr. Seth Shostak.