# The Trash We've Left on the Moon

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The lunar surface is strewn with hundreds of manmade items, from spacecraft to bags of urine to monumental plaques.

The remains of the Apollo 17 site in the moon's Taurus-Littrow Valley -- an image, released in 2011, sharp enough to show the tracks of the astronauts and their lunar rover in unprecedented detail. At top left you can see the mission's ALSEP, or its package of scientific instruments. In the centre is the lunar module's descent stage ("Challenger"), as well as the module's experimental pallet, the ladder leading down to the lunar surface, and the life-support backpacks (PLSS) that crew members Gene Cernan and Jack Schmitt tossed out of their ascent module just before leaving the moon. You can also see paths left by walking astronauts and tracks left by lunar buggies. The image was captured by NASA's Lunar Reconnaissance Orbiter, some 13 to 15 miles above the moon's surface. (NASA/GSFC/Arizona State University)

Earlier this week, two probes that had spent the past year orbiting the moon for NASA's GRAIL mission slammed into the lunar surface, destroying themselves and their communications connection to Earth.

None of this was an accident: Crash-landings like this are a typical method of bringing unmanned lunar missions -- and unmanned planetary missions in general -- to a close. This means, however, that NASA's typical method of mission conclusion involves, inevitably, leaving debris strewn on planets across our solar system. And it means that the moon, in particular, currently hosts nearly 400,000 pounds of man-made material. In epic terms, the lunar surface bears human footprints that are as figurative as they are literal, objects of earthly origin that have found their final resting place in the most otherworldly mausoleum imaginable. In less epic terms: We regularly leave trash on the moon.

A map of the Apollo 11 landing site -- now deemed a "lunar heritage site" -- including a specification of its "toss zone" (U.S. Geological Survey Apollo II Traverse Map via the Lunar Legacy Project)

Most of that debris is accounted for by the wreckage of spacecraft -- more than 70 vehicles in all, their remains scattered at intervals over the lunar surface. The rest of it, however, is accounted for by smaller pieces of detritus, objects jettisoned because they had served their purpose, and then outlived their utility, to their respective missions: geological tools, bodily waste, solemn monuments to accomplishment and sacrifice. Buzz Aldrin and Neil Armstrong alone left more than 100 items on the Sea of Tranquility, some of those being shovels and rakes, one being the plaque announcing to the world -- and the worlds beyond it -- that "we came in peace for all mankind."

So, with that in mind, here is a rough (and only partial) inventory of the stuff mankind has left on the moon:

* more than 70 spacecraft, including rovers, modules, and crashed orbiters
* 5 American flags
* 2 golf balls
* 12 pairs of boots
* TV cameras
* film magazines
* 96 bags of urine, faeces, and vomit
* numerous Hasselbad cameras and accessories
* several improvised javelins
* various hammers, tongs, rakes, and shovels
* backpacks
* insulating blankets
* utility towels
* used wet wipes
* personal hygiene kits
* empty packages of space food
* a photograph of Apollo 16 astronaut Charles Duke's family
* a feather from Baggin, the Air Force Academy's mascot falcon, used to conduct Apollo 15's famous "hammer-feather drop" experiment
* a small aluminium sculpture, a tribute to the American and Soviet "fallen astronauts" who died in the space race -- left by the crew of Apollo 15
* a patch from the never-launched Apollo 1 mission, which ended prematurely when flames engulfed the command module during a 1967 training exercise, killing three U.S. astronauts
* a small silicon disk bearing goodwill messages from 73 world leaders, and left on the moon by the crew of Apollo 11
* a silver pin, left by Apollo 12 astronaut Alan Bean
* a medal honouring Soviet cosmonauts Vladimir Komarov and Yuri Gagarin
* a cast golden olive branch left by the crew of Apollo 11

It's easy to be a little bit appalled by this -- by the waste we have left on our pristine planetary neighbour, by our treatment of the moon as yet another landfill (lunefill?). After all, literally tons of garbage!

But the trash, in this case, is strategic -- the cost of returning to Earth being high, it is the price we pay for discovery. The items we've left on the moon are also members of an enormous ecosystem of space debris: At the moment, more than 21,000 pieces of space junk -- abandoned satellites, spent rocket stages, fragments of disintegrated spacecraft -- are orbiting the planet, shrouding Earth in a man-made mantle.

But jettisoned spacecraft aside, many of the objects that reside on the moon are there because humans have selected them, specifically, to be relics of the long history of human exploration. Swirled somewhere in the grey powder of Tranquility Base, there is an olive branch, wrought of gold and human industry. That item is technically space junk; junk, however, it is not. Space has its own way of merging loss and eternity. The location of NASA's most recently crashed lunar probes was selected specifically so as to be far away from Tranquility Base and other "lunar heritage sites." And the site of the vehicles' wreckage, the agency announced this week, will be named after Sally Ride.

This seems fitting. Not only did Ride dedicate her final years to the GRAIL mission; the lunar landscape is also a frontier that represents, to us frail humans, both proximity and eternity. Whatever remains there -- whatever we choose to leave there -- takes on, by default, a special kind of perpetuity. One other earthly object that resides on that landscape is an urn containing the ashes of Eugene Shoemaker, the famed planetary geologist who dreamed, during his life, of going to the moon. The container, composed of polycarbonate, is 1.75 inches long and 0.7 inches in diameter, and carried in a vacuum-sealed, aluminium sleeve. Around it is wrapped a piece of brass foil inscribed with this passage from Shakespeare's "Romeo and Juliet":

*And, when he shall die,*

*Take him and cut him out in little stars,*

*And he will make the face of heaven so fine*

*That all the world will be in love with night,*

*And pay no worship to the garish sun.*