

**NASA/JPL Solar System Ambassador**

**John Fontana**

***All Opinions and Commentary are the Responsibility of the Presenter***

***Picture Credit: NASA***

The Orion Spacecraft  
Paving the Way for Human Exploration



Artemis II mission by NASA is officially scheduled to launch on Wednesday, April 1st, 2026 at 6:24 pm EDT — marking humanity's return to deep space with astronauts aboard for the first time in over 50 years!

- The Crew of Artemis II:
- Reid Wiseman – Commander
  - Victor Glover – Pilot
  - Christina Koch – Mission Specialist
  - Jeremy Hansen – Mission Specialist

This powerful team will travel aboard the Orion spacecraft, flying around the Moon and back to Earth — paving the way for future lunar landings under the Artemis program.



Earth Rise

Magazine Version



True Version



# How Fast?



- At least 4.9 miles/second, or about 17,600 miles/ hour to get into orbit
- At least 7 miles/second or about 25,000 miles/hour to escape Earth's gravity
- The Kármán line, an altitude of 62 miles, is conventionally used as the start of outer space
- Gravity on the ISS (at an altitude of 254 miles) is 90% as strong as at the Earth's surface
- Orbiting objects are weightless because they are in free fall

The SLS is designed to safely send humans to deep space and can support a variety of complex missions. It will also open new possibilities for payloads, including robotic scientific missions to places like Mars, Saturn and Jupiter.

The SLS is the only rocket that can send Orion, Astronauts, and heavy cargo to the Moon in a single mission.



## Apollo Astrovan



## Artemis Astrovan

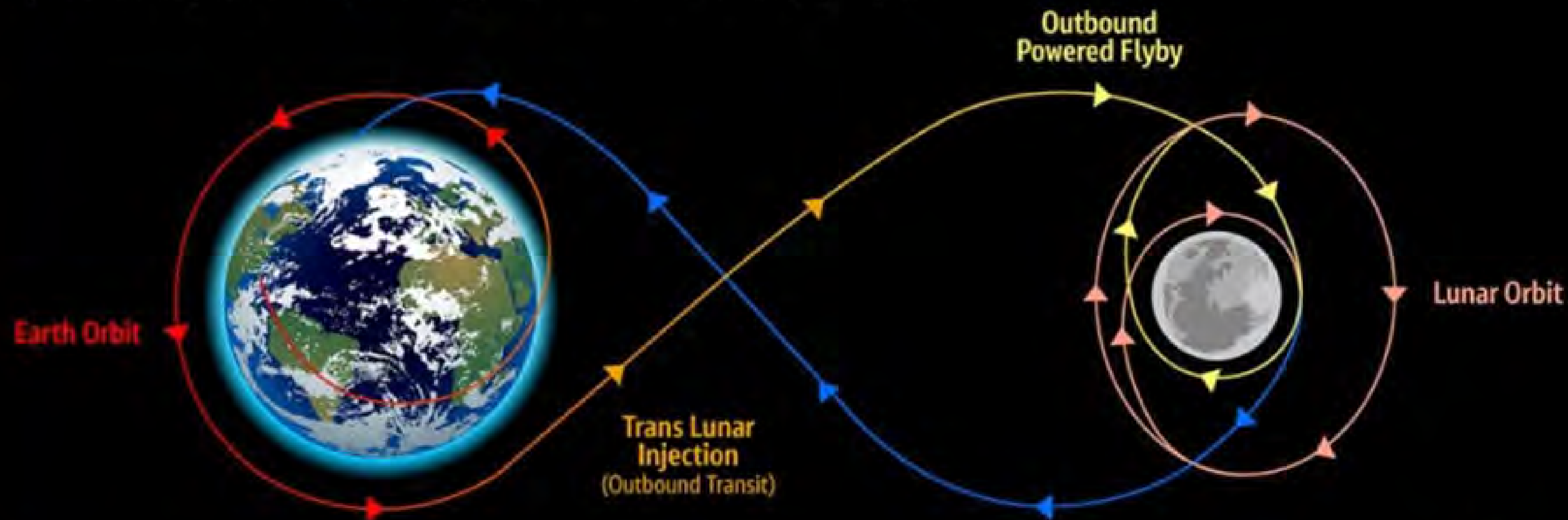


The cushy interior



# Artemis I

*The first uncrewed, integrated flight test of NASA's Orion spacecraft and Space Launch System rocket, launching from a modernized Kennedy spaceport*



Total Distance Traveled: 1.3 Million Miles  
Mission Duration: 26-42 Days  
Re-Entry Speed: 24,000 mph (Mach 32)  
CubeSats Deployed: 13



# SPACE LAUNCH SYSTEM



# SOLID ROCKET BOOSTERS

National Aeronautics and  
Space Administration



## WHAT ARE THEY AND WHAT DO THEY DO?

Two SLS Solid Rocket Boosters operate in parallel with the core stage's main engines for the first two minutes of the rocket's flight, providing the additional thrust needed for the launch vehicle to escape the gravitational pull of the Earth.

Each SLS Solid Rocket Booster has **3** assemblies:



The boosters tower **17 stories high...**  
Taller than the Statue of Liberty from base to torch.



Assembled, each  
booster weighs  
more than...

**1.6  
Million  
pounds.**

### FORWARD ASSEMBLY

### MOTOR ASSEMBLY

### AFT ASSEMBLY



- The forward assembly includes the nose cap and the forward skirt. The forward skirt houses the electronics and has the critical connection point that carries most of the forces to the rocket during launch.

- The motor assembly has five segments filled with propellant the consistency of a pencil eraser.

- The aft, or rear, assembly contains the aft skirt and the thrust vector control system, which moves the nozzle to steer the vehicle.



Boosters are designed by engineers to be **FAST & POWERFUL.**  
**2 MINUTES OF PURE AWESOME** provides more than **75% OF TOTAL THRUST** at liftoff.



**EACH BOOSTER** burns **6 TONS** of solid propellant **EVERY SECOND** and generates a **MAX THRUST OF 3.6 MILLION POUNDS.**

Each solid rocket booster on the Space Launch System rocket produces 3.6 million pounds of thrust - equivalent to 14 four-engine jumbo commercial airliners.

In this picture we see teams practice booster stacking for NASA Artemis I back in 2019.

Picture Credit: NASA



In 1968, Apollo 8 stood on the launch pad as the first spacecraft prepared to carry humans beyond Earth's orbit. Its crew relied on analog computers, slide rules, and systems with almost no redundancy by today's standards. There were no digital screens, no automated safeguards, and no margin for error.

Nearly sixty years later, Artemis II will carry the next chapter of that same quest. Scheduled for 2026, it will launch astronauts aboard Orion on top of the Space Launch System — a rocket taller, more powerful, and vastly more advanced than anything used in the Apollo era. Artemis II depends on digital avionics, real-time monitoring, layered redundancy, and decades of spaceflight lessons earned the hard way. Even though the rockets, technology, and capabilities look worlds apart, the purpose is unchanged. Artemis II exists not only to return humans to the Moon, but to build the foundation for sustainable, repeatable exploration. It shows how spaceflight doesn't erase the past — it grows from it. The destination is the same. The era, the tools, and the ambition are far greater. It is progress through evolution, not repetition.



# Orion



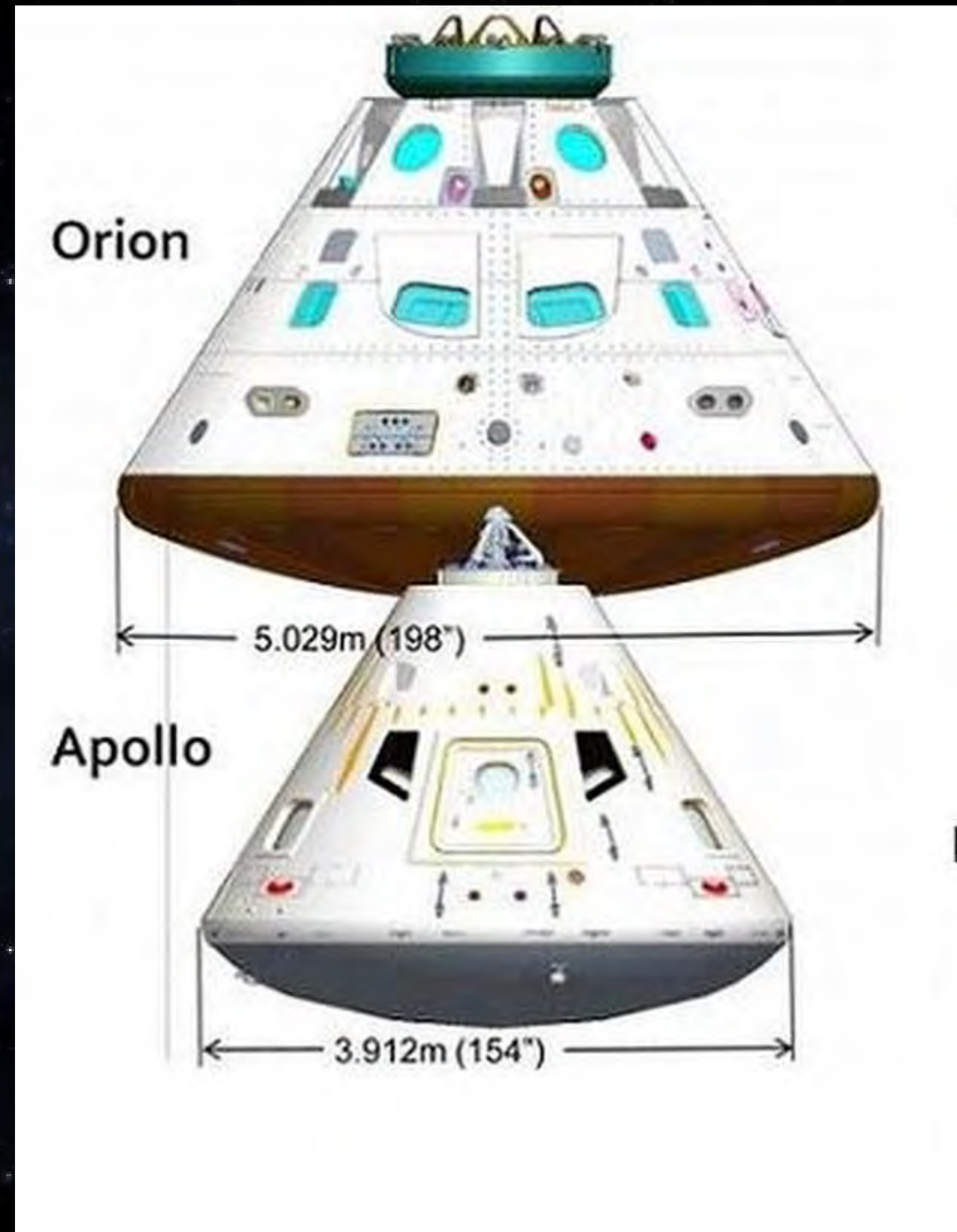
The spacecraft can carry up to six crew members and is designed to support astronauts traveling hundreds of thousands of miles from home, where getting back to Earth takes days rather than hours.

The name Orion comes from the winter star constellation of the same name.



ORION

Unlike Apollo, the deck of ORION is actually 2-3 feet higher than the base. This allows for a pop-up privacy toilet and extra storage capacity. The walls are also designed for cargo storage. The capsule is operated via ground control and fold down MFD screen computer panels. Gone are the myriad number of switches and panels. The crew sleeps in cocoon-like hammocks.



# The Roles of the Artemis II Crew



Four astronauts will travel around the Moon aboard Orion on Artemis II — NASA's first crewed mission in the Artemis campaign. The approximately 10-day flight will test systems needed for future lunar missions. Each crew member has a specific seat and role inside Orion, from piloting the spacecraft to managing crew systems and emergency procedures. Learn how the crew will be positioned during launch and landing and what each will do during the mission.

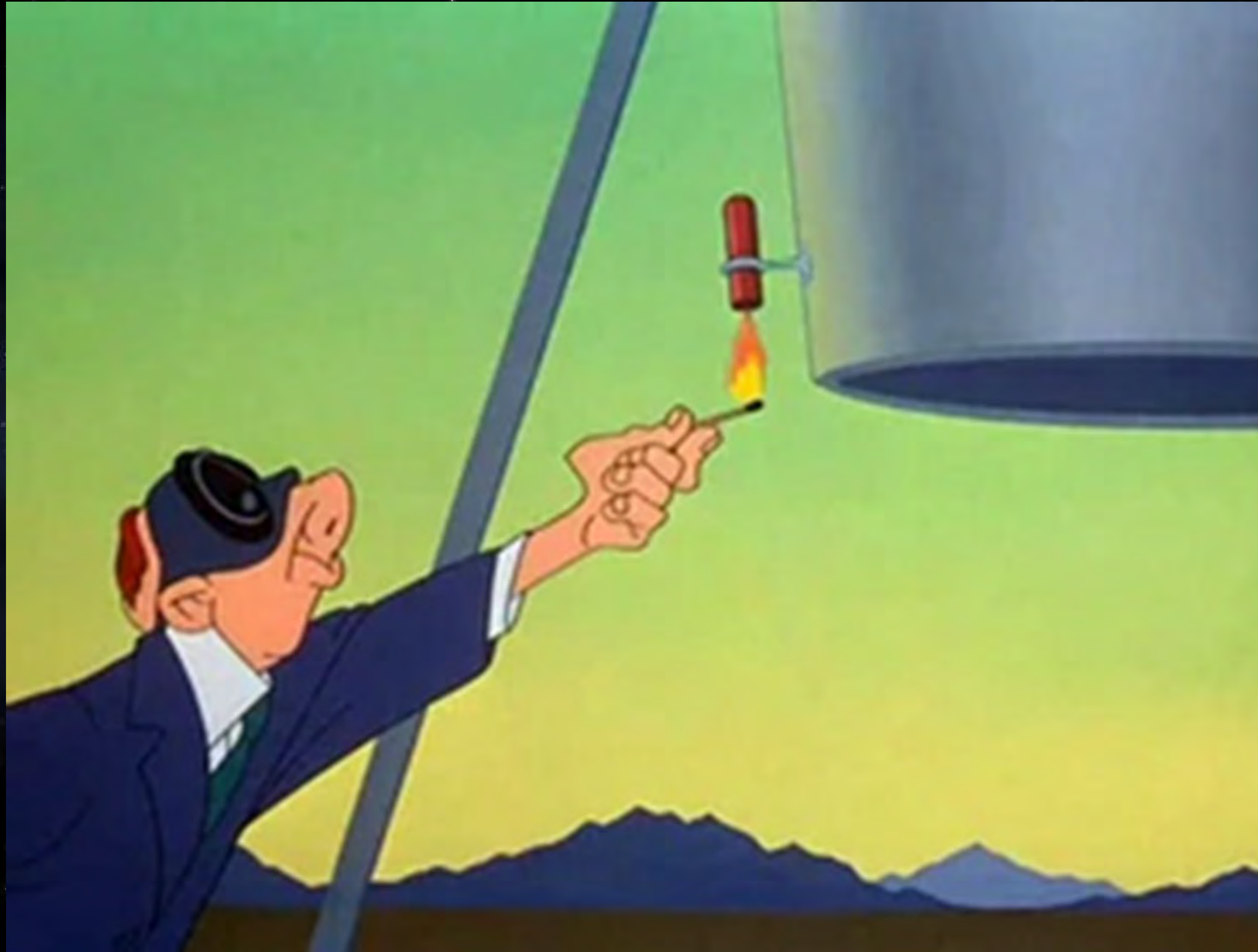
**1 COMMANDER**  
Reid Wiseman / NASA

**2 PILOT**  
Victor Glover / NASA

**3 MISSION SPECIALIST 2**  
Jeremy Hansen / CSA

**4 MISSION SPECIALIST 1**  
Christina Koch / NASA

# Launch



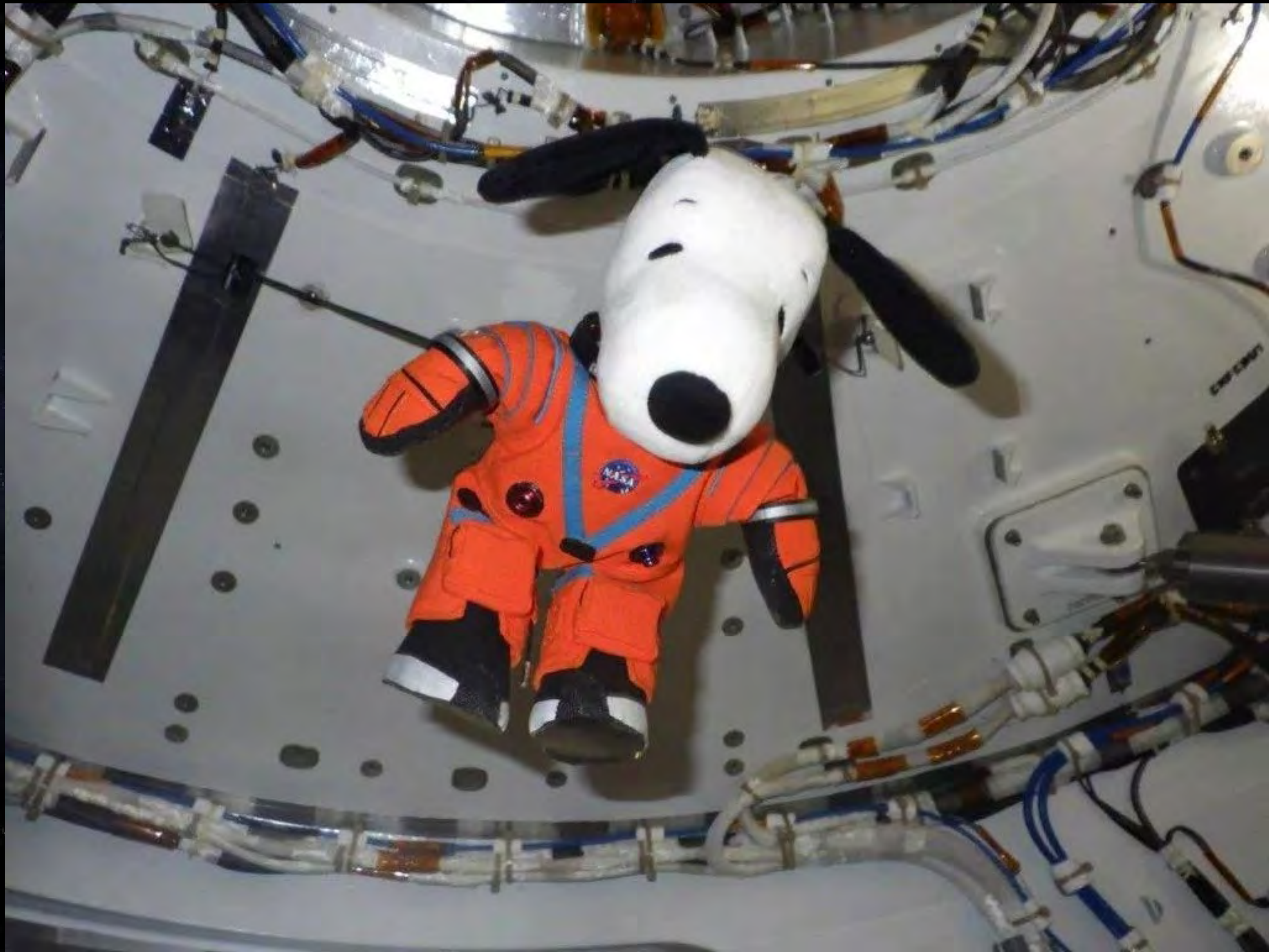


The background of the image is a dark, atmospheric scene of a launch event. In the center, a bright, glowing orange and yellow flame or fire is visible, likely from a rocket engine. The scene is framed by dark, industrial structures, possibly launch pads or support towers, with some blue lighting accents. The overall mood is dramatic and high-tech.

# ARTEMISI

## LAUNCH

Snoopy Zero Gravity Indicator



## Why Space Launches Travel East

Space launches travel east to take advantage of the Earth's natural rotation, which provides a significant speed boost—about 1,040mph at the equator—reducing the fuel and energy required to reach orbit. This eastward "tailwind" boosts payload capacity, making launches more efficient and cost-effective.

- **Rotational Boost:** Earth rotates from west to east. Launching in this direction adds the planet's rotational speed to the rocket's own velocity, allowing it to reach the ~17,500 mph required for orbit with less effort.
- **Energy Efficiency:** By saving on fuel, rockets can carry heavier payloads, notes Dream-Aerospace.
- **Safety Considerations:** Many launch sites are located on the east coast of landmasses (e.g., Kennedy Space Centre) to ensure that any failed rocket debris falls into the ocean rather than on populated areas, note Quora users.
- **Equatorial Advantage:** Launching near the equator offers the highest velocity advantage, which is why sites like Kourou in French Guiana or Kennedy Space Center are popular. (James Webb Space Telescope)

Launch Abort System: Launchpad Abort or Failed Launch:  
From zero to 405mph in Two Seconds  
Peak Height: One Mile  
Over 11gs  
Equivalent to Lifting 26 Elephants



# Launch Abort System Jettison



SPACE COM

An image of the elevators at Launch Pad 39B, whose doors were blown off by the launch of Artemis I. (Image credit: NASA)

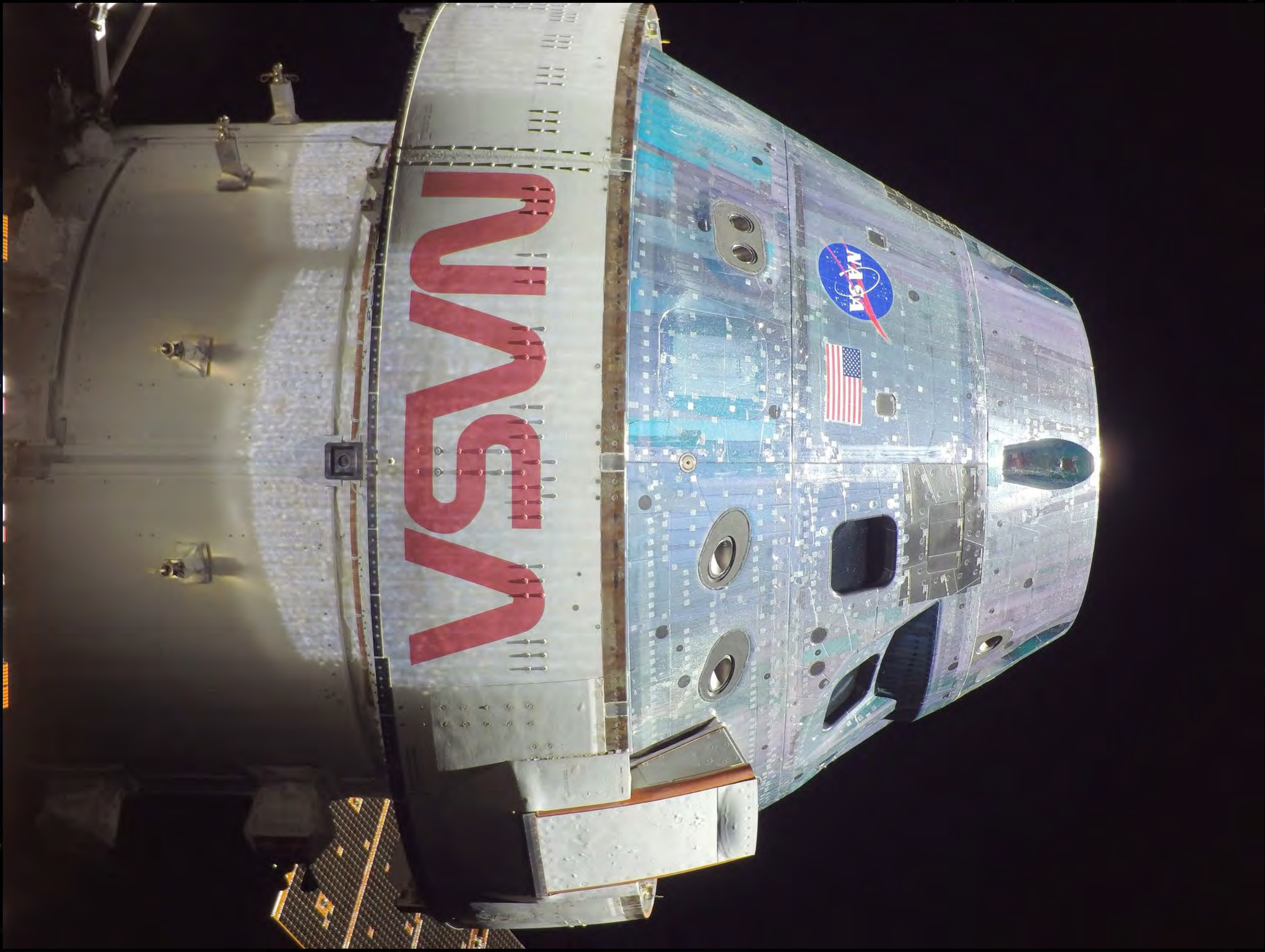


## How Loud Was The Launch?

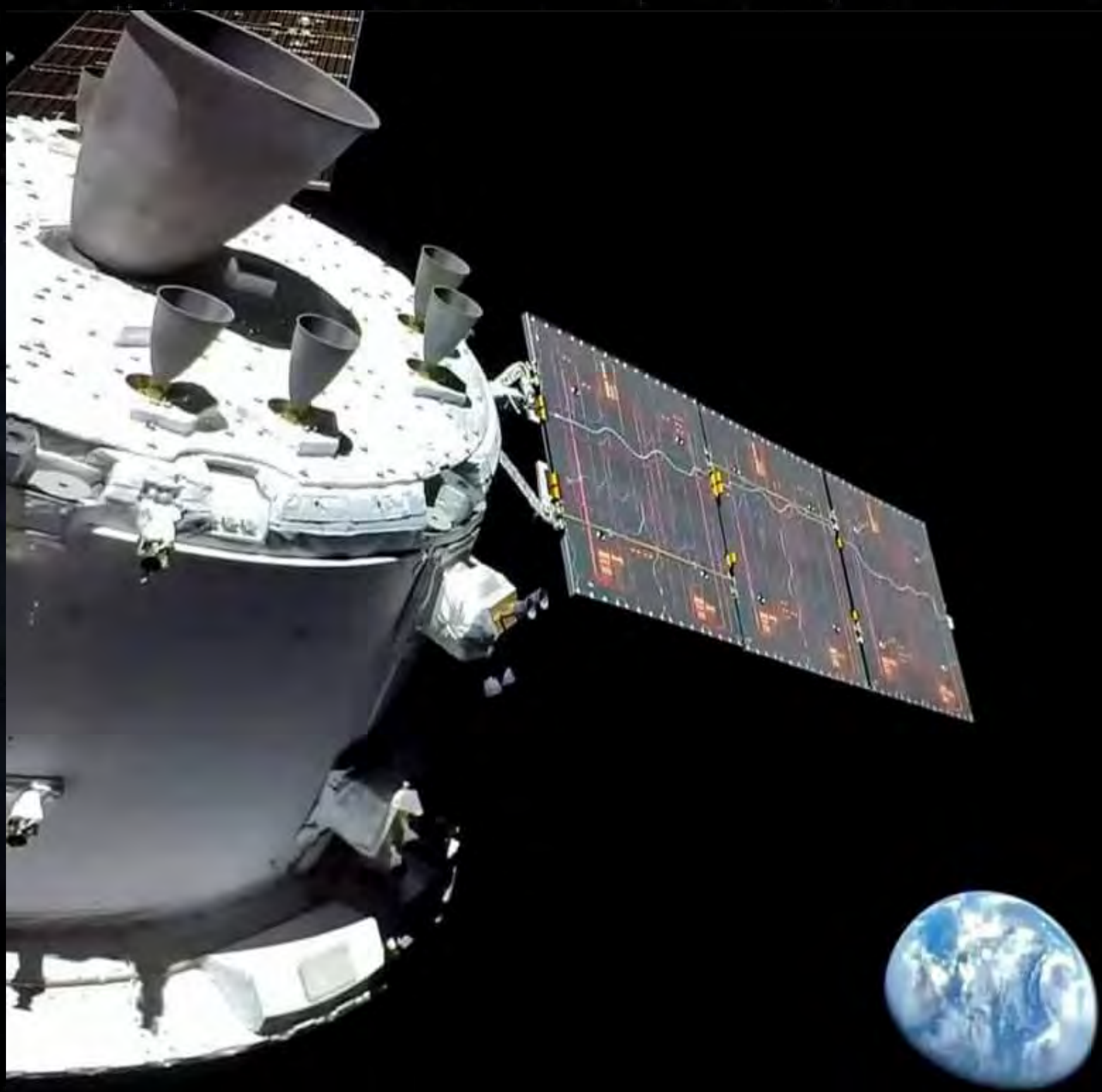
- An analysis done by researchers suggests the launch was loud enough to cause ear pain or hearing loss, even from three miles away.
- At roughly one mile from the launch site (1.5 kilometers, to be exact), the rocket's noise was 136 decibels, which is roughly equivalent to standing 100 yards from a jet engine.
- At a little more than 3 miles (5.2 km) away, it reached 129 decibels—about as loud as a chainsaw.
- Hearing loss can occur with less than two minutes of exposure to 110 decibels, and ear pain and injury can begin at around 120 decibels, per the Centers for Disease Control and Prevention.
- The crackling sound produced by the rocket, from three miles away, was roughly 40 million times louder than the popping noises from a bowl of Rice Krispies cereal in freshly poured milk.

# Artemis I















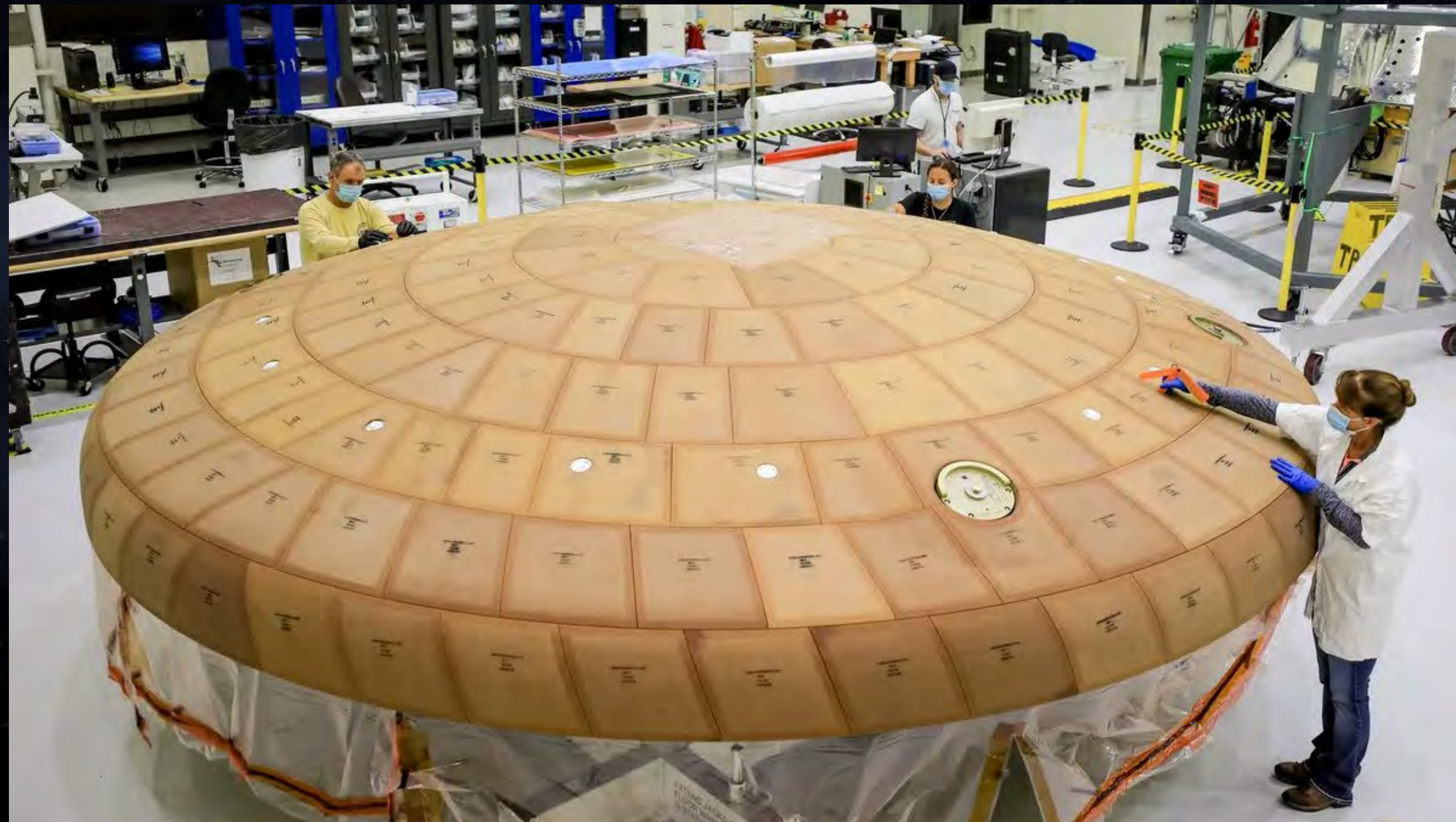
The heat shield for NASA's Orion crew capsule is very large but of a traditional design. It features an ablative material called Avcoat. (Image credit: NASA/Isaac Watson)

#### Cause of the issue

In a post-flight analysis of the Artemis I heat shield, NASA identified more than 100 locations where ablative thermal protective material was liberated during Orion's speedy reentry.

NASA, along with contractors and an independent review team, launched an investigation to establish the technical cause of the issue. An analysis was done, including over 100 tests at unique facilities across the country.

The finding: Orion's heat shield did not allow for enough of the gases generated inside a material called Avcoat to escape. This permitted pressure to build up and cracking to occur, causing some charred material to break off in several locations, NASA reported.



## Orion Heat Shield

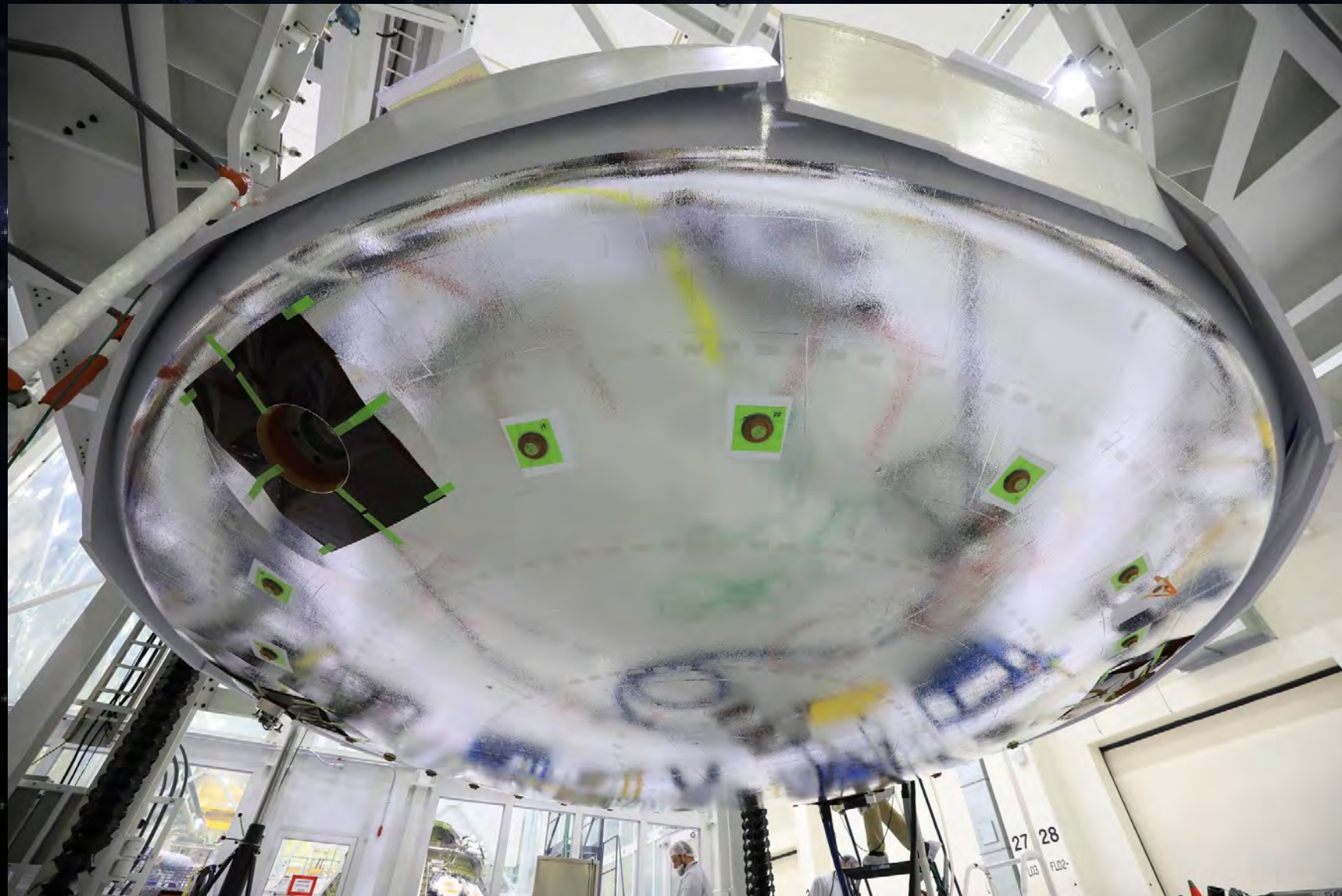
16.5 Feet Wide

Installation of the heat shield for the Artemis II Orion spacecraft.

During the high-speed, 25,000 miles per hour return from lunar distance, the thermal protection system of Orion's crew module must endure blistering temperatures to keep crew members safe. Measuring 16.5 feet in diameter, Orion's heat shield is the largest of its kind developed for missions carrying astronauts.

High temperatures during atmospheric re-entry are primarily caused by compressive heating, where the spacecraft moves at hypersonic speeds (over 17,500 mph) and rapidly compresses the air in front of it. This intense compression, combined with aerodynamic heating, creates a shock layer of plasma exceeding 3,000°F (often up to 5,000°F) that radiates heat to the craft.

Photo credit: NASA/Cory Huston



Orion Heat Shield  
After Enduring Temperatures of About 5,000 Degrees Fahrenheit  
Photo credits: NASA/Cory Huston



The Artemis I Moon mission had a heat shield issue. NASA doesn't think it will happen again on Artemis II

"We support NASA's decision to fly the Artemis II mission with its current heat shield and are committed to seeing Orion safely launch and return on its historic mission to the moon with crew onboard."

During its high-speed return from the Moon, the thermal protection system of Orion's crew module must endure blistering temperatures to keep crew members safe. Measuring 16.5 feet (5 meters) in diameter, Orion's heat shield is the largest of its kind developed for missions carrying astronauts. (Image credit: NASA)

The high-speed, safe return to Earth of the Artemis II Moon crew depends on the thermal protection system of the mission's Orion's crew module. It must endure blistering temperatures to keep crew members safe.

However, following the uncrewed Artemis I lunar flight test in late 2022, it was found that ablative thermal protective material had unexpectedly chipped away from Orion's heat shield during its plunge through Earth's atmosphere.



### A key factor

During Orion's Artemis 1 reentry, the craft used what's called a skip guidance entry technique.

That maneuver had Orion dipping into the upper part of Earth's atmosphere and using atmospheric drag to reduce speed. Orion then used the aerodynamic lift of the capsule to skip back out of the atmosphere and then reenter for final descent under parachutes to splashdown.

### Skip the skip

"This modified trajectory involves a slightly steeper entry profile and elimination of a skip, resulting in shorter downrange landing," according to Blaine Brown, Orion spacecraft mechanical systems director for Lockheed MartinBrown. "We performed extensive testing and analysis on the Avcoat block materials to ultimately reproduce the char liberation phenomenon seen on Artemis 1."

Brown said that the material being used on Artemis 3 — NASA's first human return-to-the-moon mission, targeted to launch in 2028 — is actually the same formula that was flown on Artemis 1 and that will fly on Artemis 2.

(Image credit: NASA Office of Inspector General)

**Figure 3: Orion Heat Shield Char Loss After Artemis I Mission**

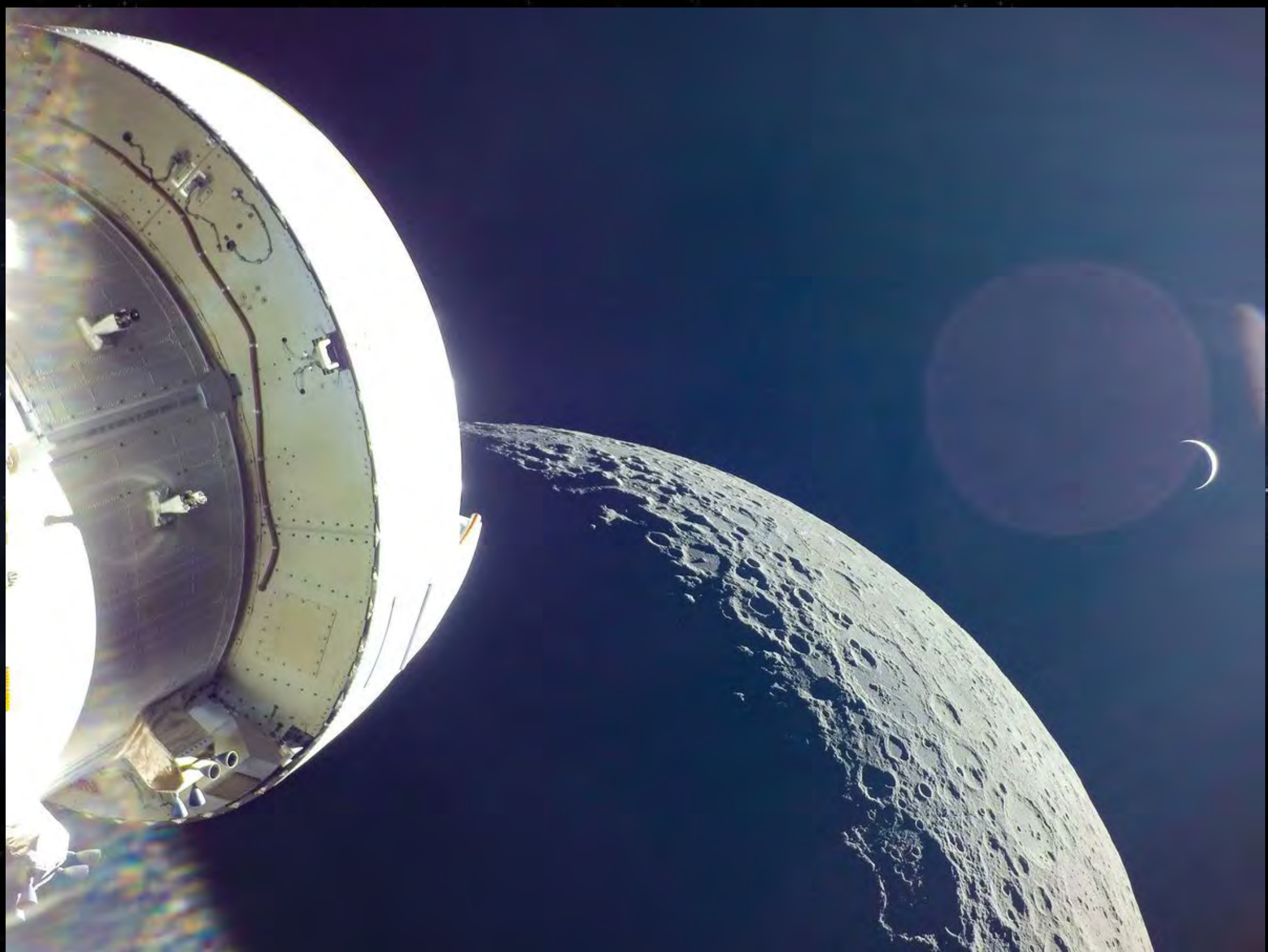


Images show heat shield char loss post-Artemis I mission, including cavities resulting from the loss of large chunks of the heat shield char during reentry.

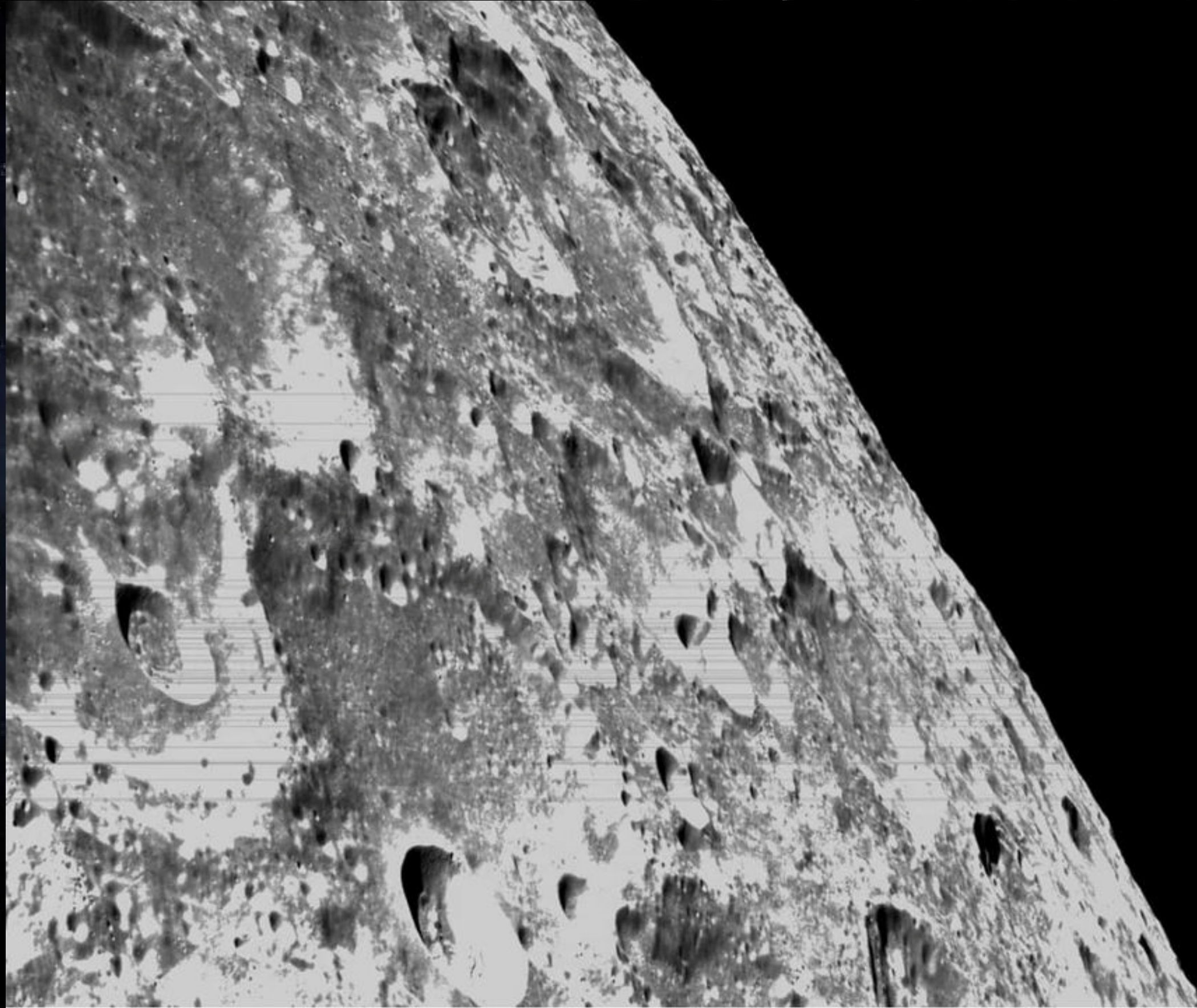
# VIEWS OF THE MOON

## Artemis I





A close black-and-white photo of the surface of the Moon showing craters of various sizes dotting its surface. The Moon appears in shades of gray on the left of the image, with the blackness of space on the right third of the photo.



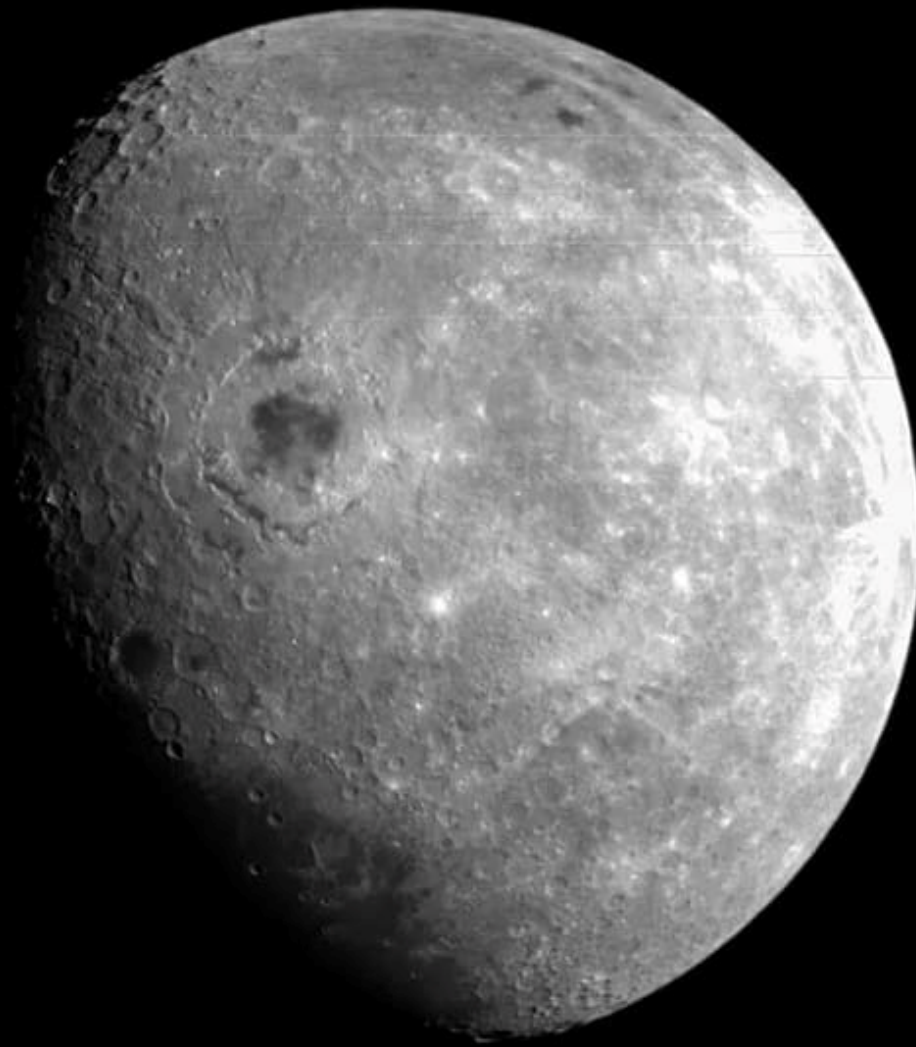
This closest photo shows craters on top of craters, and the texture of the Moon is scarred with asteroid and meteor impacts.



A view of the south pole of the Moon that marks permanently shadowed regions (PSRs), where the Sun never shines. (Image credit: NASA's Goddard Space Flight Center Scientific Visualization Studio)



# The Far Side of the Moon As Shot by Artemis I



Our Moon's 2 sides are more different than we thought, lunar samples reveal

China's Chang'e 6 mission returned the first-ever far-side lunar samples, revealing new insights into the Moon's interior.

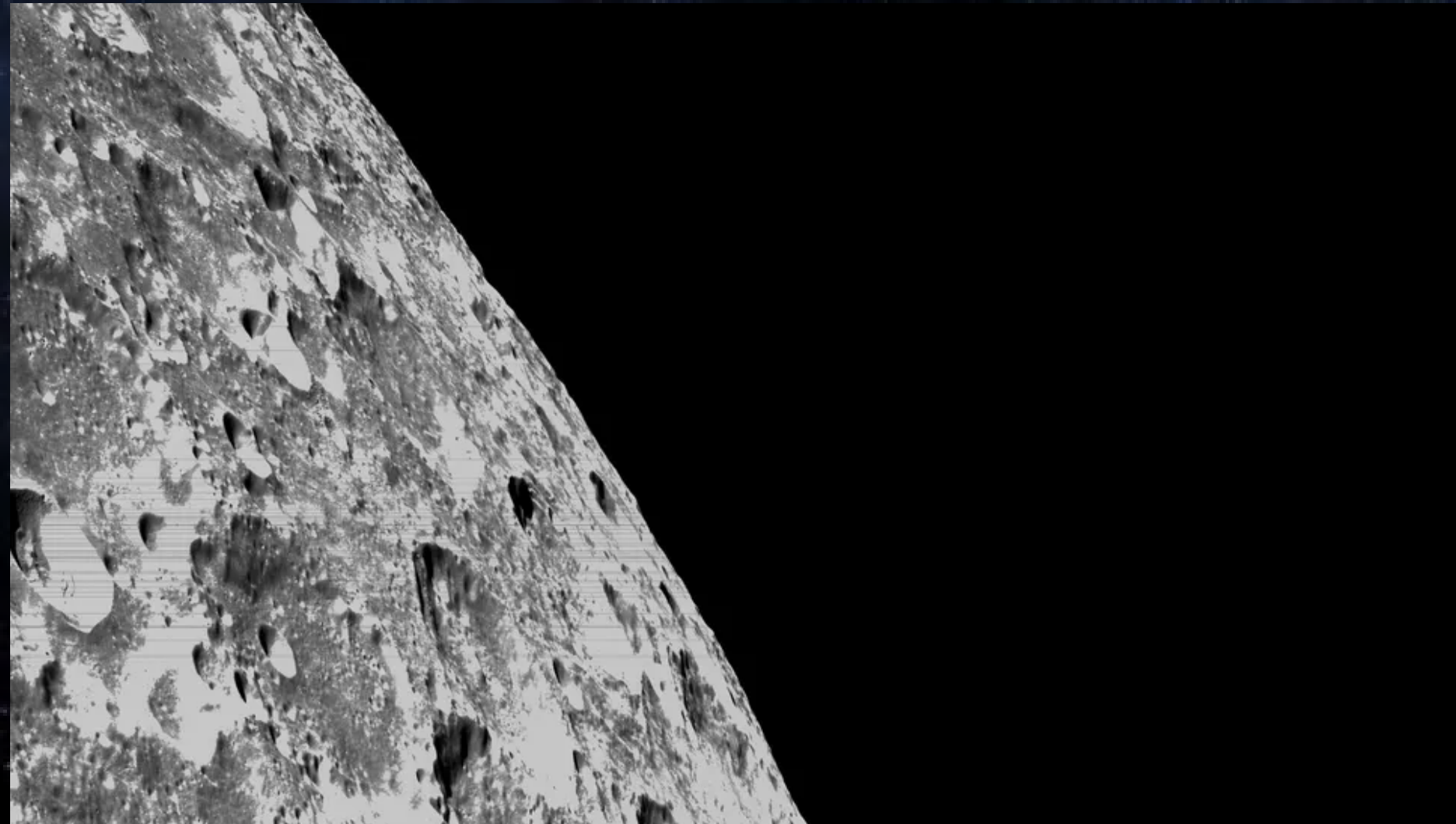
Lunar samples reveal the far side of the moon, hidden from Earth's view, may have a cooler interior than the near side.

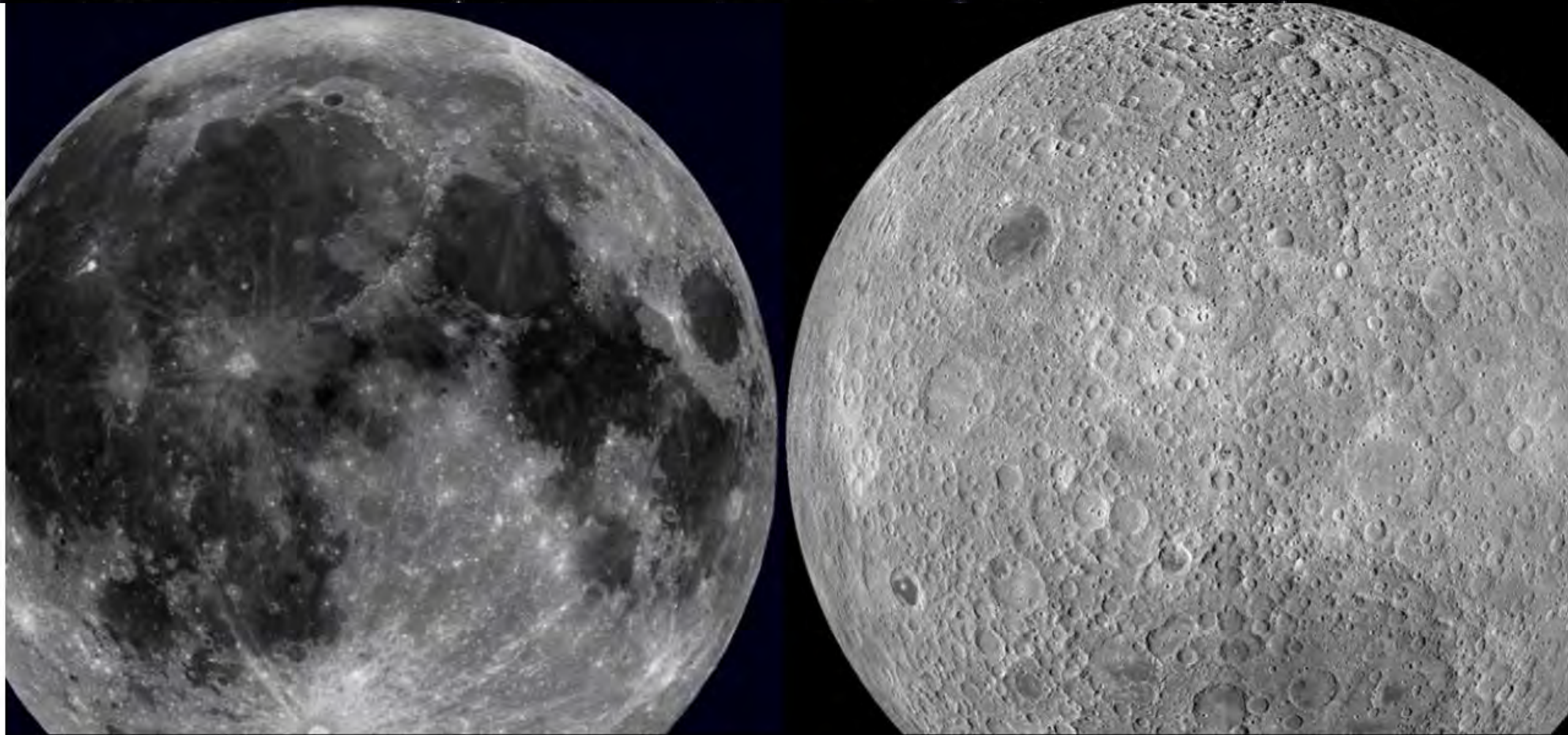
China's Chang'e 6 mission returned the first-ever samples from the far side of the moon in June 2024. A recent analysis of these fragments, collected from a vast crater inside the Moon's South Pole–Aitken (SPA) basin, found that the samples were about 180°F (100°C) cooler than near-side samples gathered by NASA's Apollo missions.

"The near side and far side of the Moon are very different at the surface and potentially in the interior. It is one of the great mysteries of the Moon," Yang Li, co-author of the study, said in a statement. "We call it the two-faced moon. A dramatic difference in temperature between the near and far side of the mantle has long been hypothesized, but our study provides the first evidence using real samples."

The far side has a thicker crust, is more mountainous and heavily cratered, and contains far fewer lava-filled basins. The new findings suggest these differences extend beneath the surface into the Moon's interior.

The crater-riddled far side of the Moon seen by the Orion spacecraft. (Image credit: NASA)



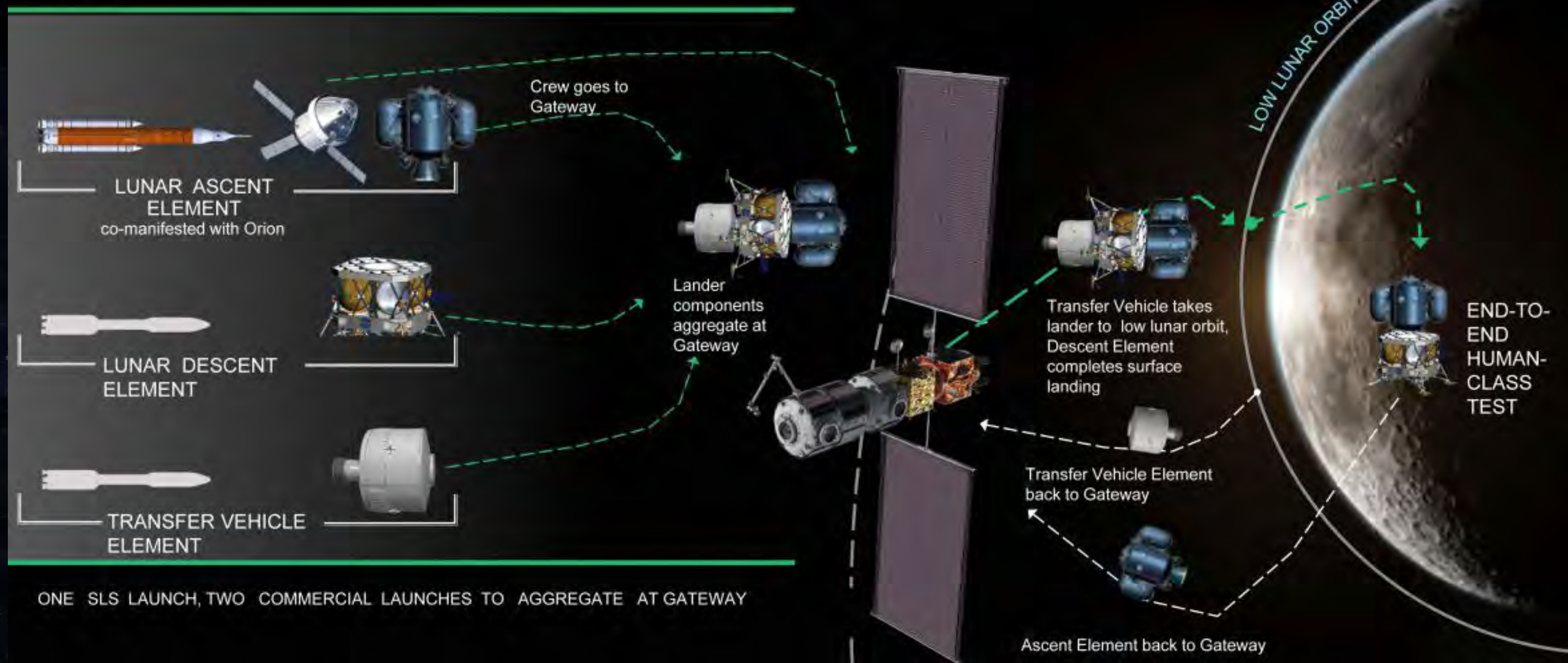


The Moon's nearside (left) is dominated by vast volcanic deposits, while the far side (right) has far fewer. Why the two sides are so different is an enduring lunar mystery.

On the 13th day of the Artemis I mission, the Orion spacecraft captured Earth slip behind the moon. The footage and has been time-lapsed and looped here.  
Credit: NASA



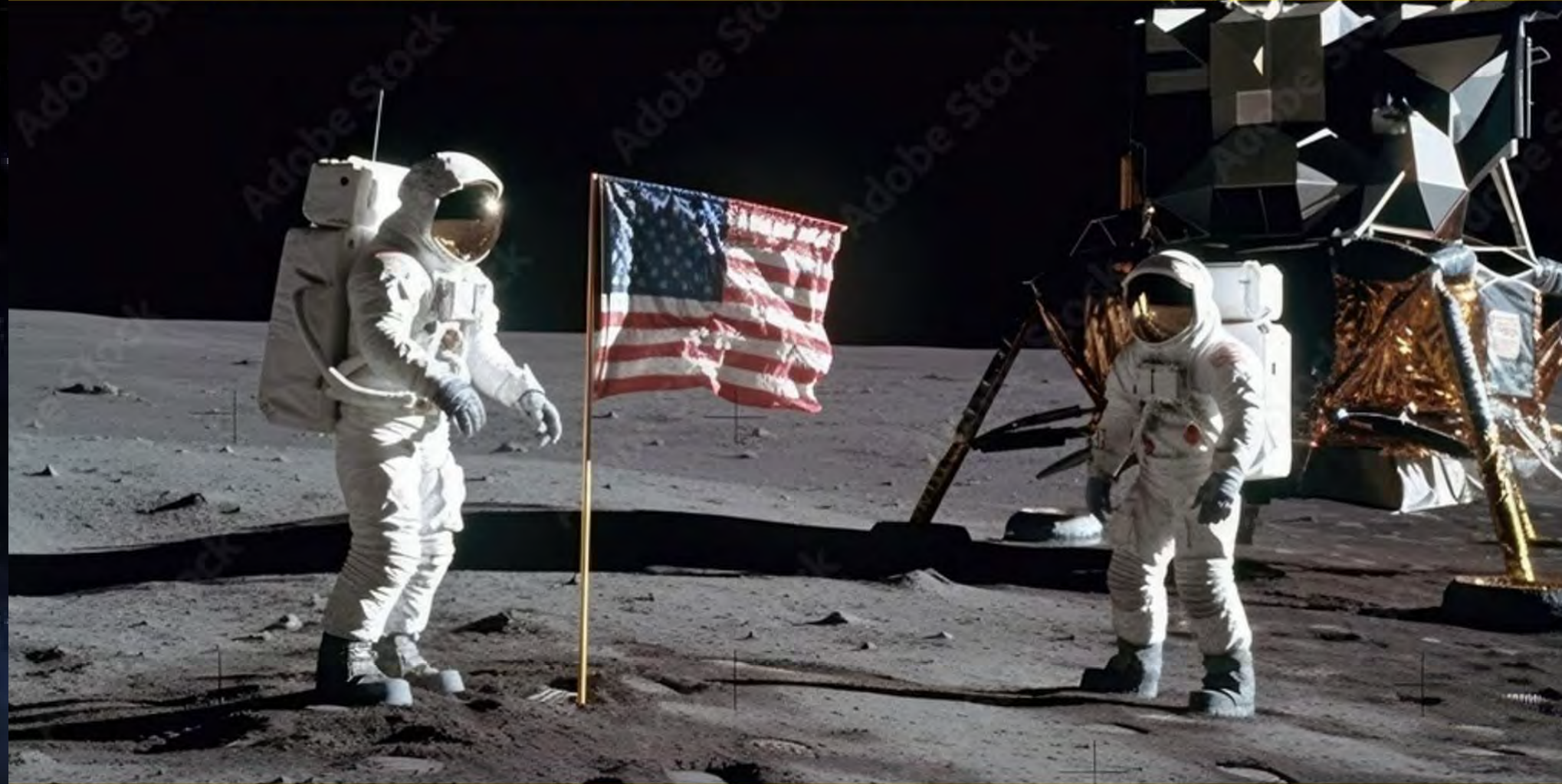
SPACE



NASA had been planning a three-stage concept for lunar landings.

- 1) a transfer vehicle to move the lander from the Gateway to low lunar orbit
- 2) a descent stage to go to the surface
- 3) an ascent stage to return directly to the Gateway.

# Moon is abundant in Oxygen



Based on lunar rock samples returned to Earth, during the Apollo missions, scientists know that the moon's soil, or regolith, contains about 40 to 45 percent oxygen by weight. This makes oxygen the most abundant element on the moon's surface. But this oxygen is bound up chemically as oxides in the form of minerals which makes it difficult to harvest.

**Follow**



Think New

Scientists extracted water and oxygen from Moon dust using sunlight. Could it work on the lunar surface?

Soil excavated from the Moon could be used to produce oxygen and methane, which could be used by lunar settlers for breathing and for rocket fuel.

Studies have shown that transporting supplies from Earth to any future Moon base would be expensive because the greater the mass of cargo, the harder a rocket has to work to launch into space. Studies have indicated that it would cost \$83,000 to transport just one gallon of water from Earth to the Moon, and yet each astronaut would be expected to drink 4 gallons of water per day.

Fortunately, the Moon has plentiful water. Brought to the Moon by impacts of comets, asteroids and micrometeoroids, and even by the solar wind, water lurks in permanently shadowed craters at the lunar poles.

Extracting the water for drinking is relatively easy and there are numerous technologies that describe how this can be done, including heating the regolith by focusing sunlight onto it. However, the Chinese team has been able to take this one step further.

An artist's impression of a Moon base. (Image credit: ESA - P. Carril)



# Helium 3

It could be an alternative source of energy.

It could provide safer nuclear energy in a fusion reactor, since it is not radioactive and would not produce dangerous waste products.

Large amounts of energy can be generated by even small amounts of He3.

There is about 1.1 million metric tons of Helium 3 on the Moon.

It is down only a few meters in the regolith.

Issues:

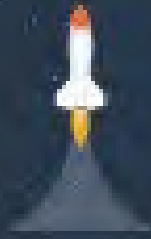
- The mining operation

- Transfer to Earth

# WHY MINE THE MOON?

Geological surveys show that the moon contains 3 crucial elements:

## Water



Vital for supporting life and agriculture beyond Earth; can be converted into rocket fuel

## Helium-3 (<sup>3</sup>He)



Rare element sought for future developments in energy sector like nuclear fusion

## Rare earth metals (REMs)



The fifteen lanthanides, as well as scandium and yttrium – used in modern electronics and mostly produced in China



Smartphones, computers and medical equipment: all of these rely on valuable materials like copper, aluminum, iron and REMs.

## REMS ARE VITAL TO EMERGING TECHNOLOGIES.



# 90%

of the world's REM supply is produced in China

Yet

## 15-20 YEARS:



how long China claims its reserves may last for

- Space “gas stations”
- Helium-3 (substitute for fossil fuels)
- Rare earth metals mining

# Artemis II



## Distance Beyond the Moon

Artemis I: 43,471 beyond the Far Side.

Distance from Earth: 268,563 miles

Artemis II: 4,000 – 6,000 miles beyond the Far Side

Distance from Earth: 250,000 to 280,000 miles

2/21/2026

NASA announced 2nd stage Helium flow issue  
on Artemis II. Rollback to VAB confirmed by  
NASA Administrator Isaacman.

## Artemis II Delay

### Key Problems with Artemis II (2026):

- **Helium System Failure:** An inability to achieve proper helium flow to the Interim Cryogenic Propulsion Stage (ICPS) was detected, likely caused by a failed quick-disconnect umbilical interface or check valve.
- **Hydrogen Leaks:** Similar to Artemis I, the rocket experienced persistent liquid hydrogen leaks at the tail service mast umbilical during fueling, Space.com reports.
- **Rollback Required:** Because the faulty components are located within the launch vehicle stage adapter, the Space Launch System (SLS) had to be rolled back from the launch pad to the Vehicle Assembly Building (VAB) for repairs, The New York Times and Aerospace Global News confirm.

### Artemis I Legacy Issues:

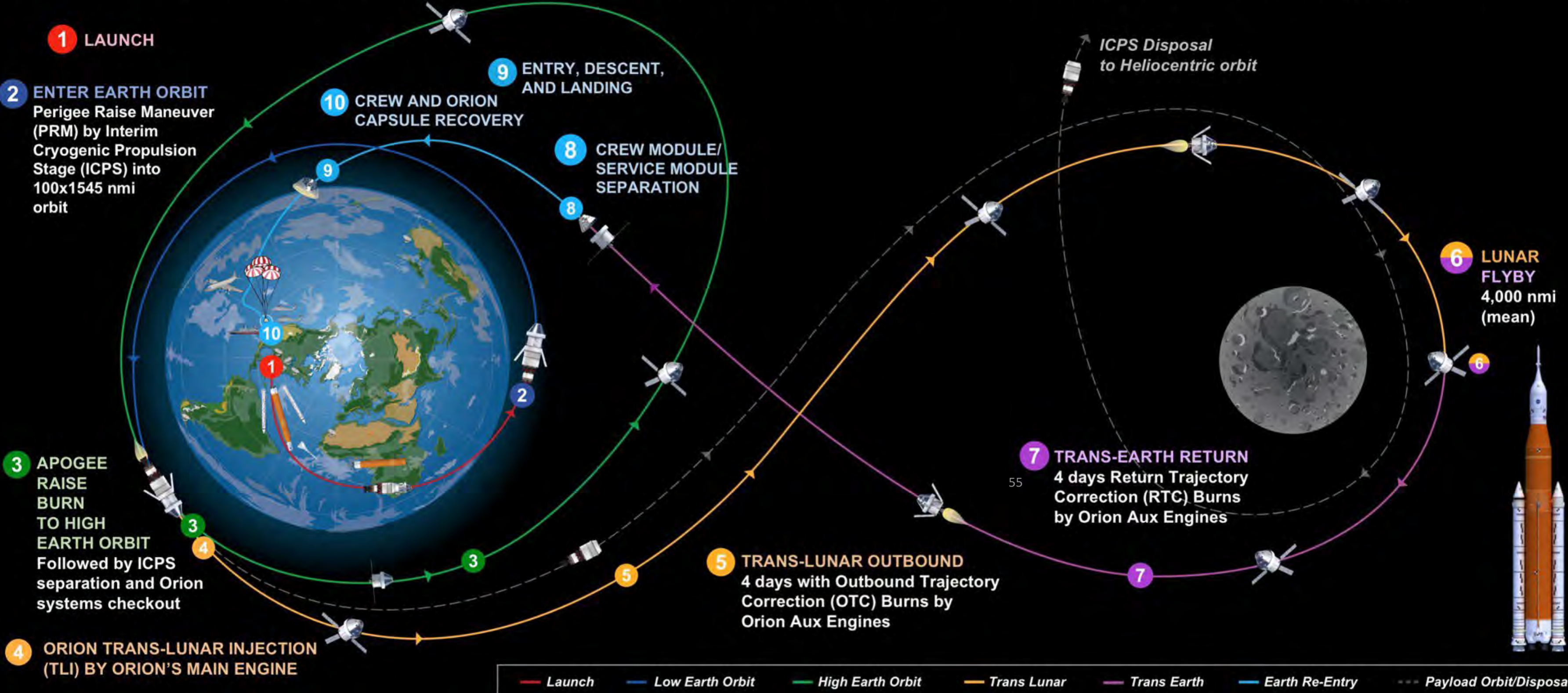
- **Heat Shield Erosion:** During the 2022 Artemis I mission, the Orion heat shield experienced unexpected cracking and char-loss.

Despite these setbacks, it was noted that the heat shield on Artemis I still performed within safety tolerances for a crew.

# Artemis 2



Crewed Hybrid Free Return Trajectory, demonstrating crewed flight and spacecraft systems performance beyond Low Earth Orbit (LEO)

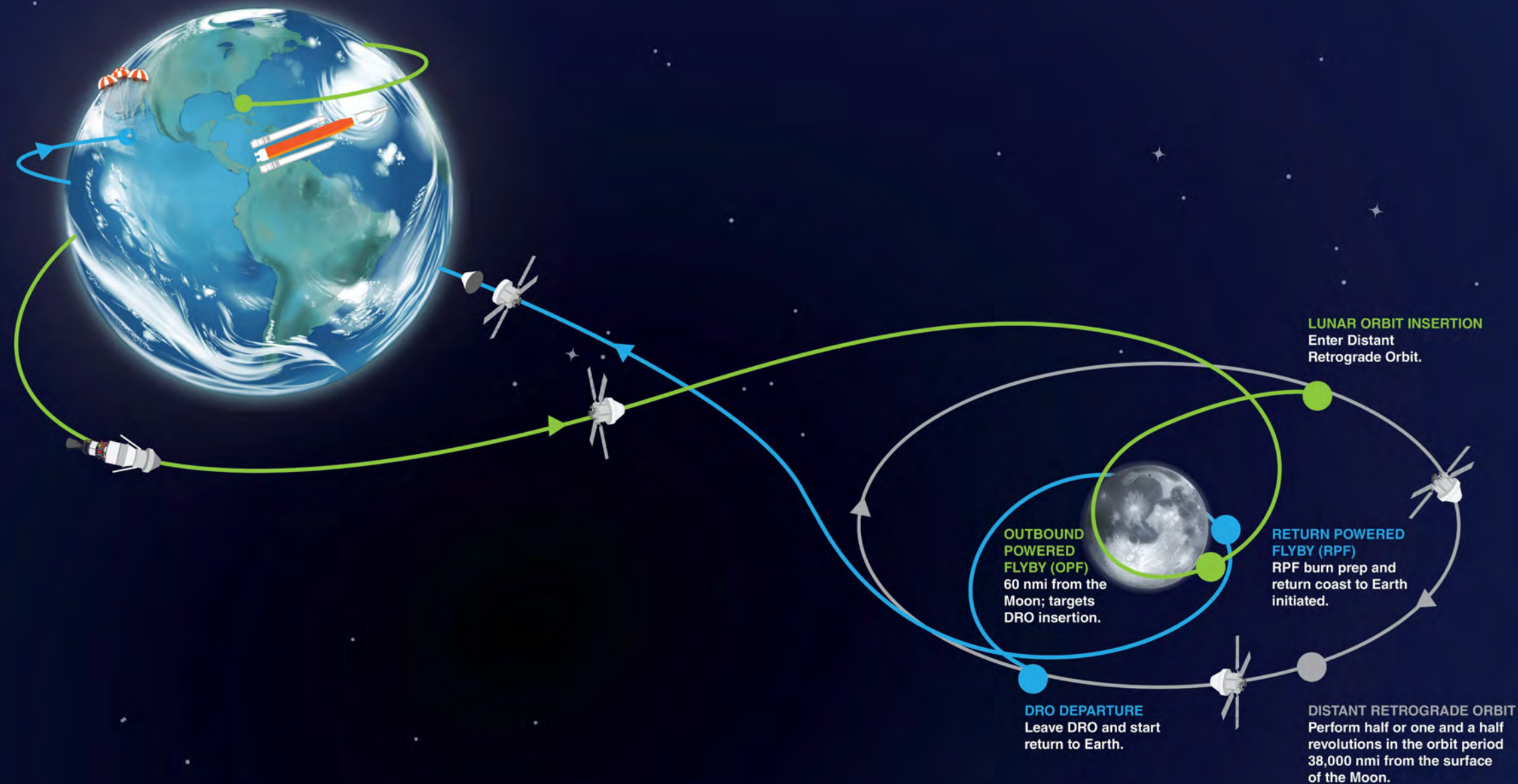


SLS Configuration (Block 1) with Human Rated ICPS | 15x1200 nmi (27.8x2222.4 km) insertion orbit | 28.5 deg inclination

4 astronauts | Mission duration: 10 Days | Re-entry speed: 24,500 mph (Mach 32)

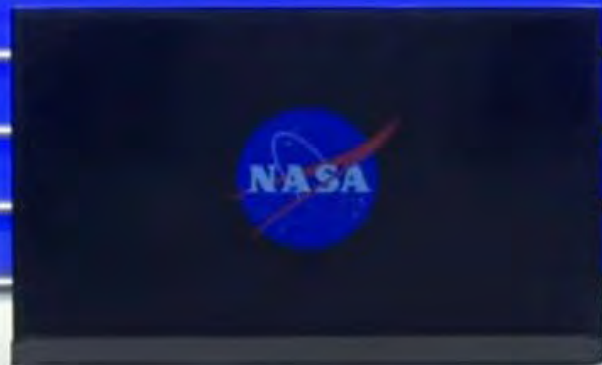
## Retrograde Orbit

The Orion spacecraft entered a retrograde orbit in Artemis I. It was a "distant retrograde orbit" (DRO), a very big orbit around the Moon. "Distant" relates to high altitude, while "retrograde" means that it will orbit the Moon in the opposite direction to the one in which the Moon spins. In other words Orion will go around the Moon the opposite direction to the Moon's orbit around the Earth. Distant retrograde orbit is just the easiest and very stable orbit because of its interactions with two points of the planet-moon system as objects are balanced between the gravitational pulls of two large masses where objects tend to stay put which means that the perfect use of the Earth and the Moon gravity to maintain that orbit; kind of like a Lagrange point, so if Orion space module did nothing it would never leave that orbit which makes it a perfect test orbit.



# ARTEMIS UPDATE

NASA



# The New **Moon Plan**



**Artemis II** → *Crewed mission around the Moon*



**Artemis III** → ***Test mission*** (no lunar landing)



**Artemis IV** → ***First Artemis human Moon landing***

***The destination didn't change — the strategy did.***



# New Artemis Campaign Timeline

2026

Artemis 2 mission will launch and circle around the far side of the moon.

2027

Artemis 3 mission proposed launch by mid-2027. Artemis 3 will no longer land on the moon but launch on SLS and Orion capsule and will rendezvous with Starship or Blue Moon landers.

2028

Artemis 4 mission proposed to launch and land on the moon.  
Opportunity for Artemis 5 mission launch.



**SPACE**.com

February, 2026

### New plan to go to the Moon.

In a recent announcement, NASA revealed an increased cadence of lunar missions, committing to at least one surface landing every year following 2027. This ambitious schedule includes standardizing vehicle configurations and adding a new mission in 2027.

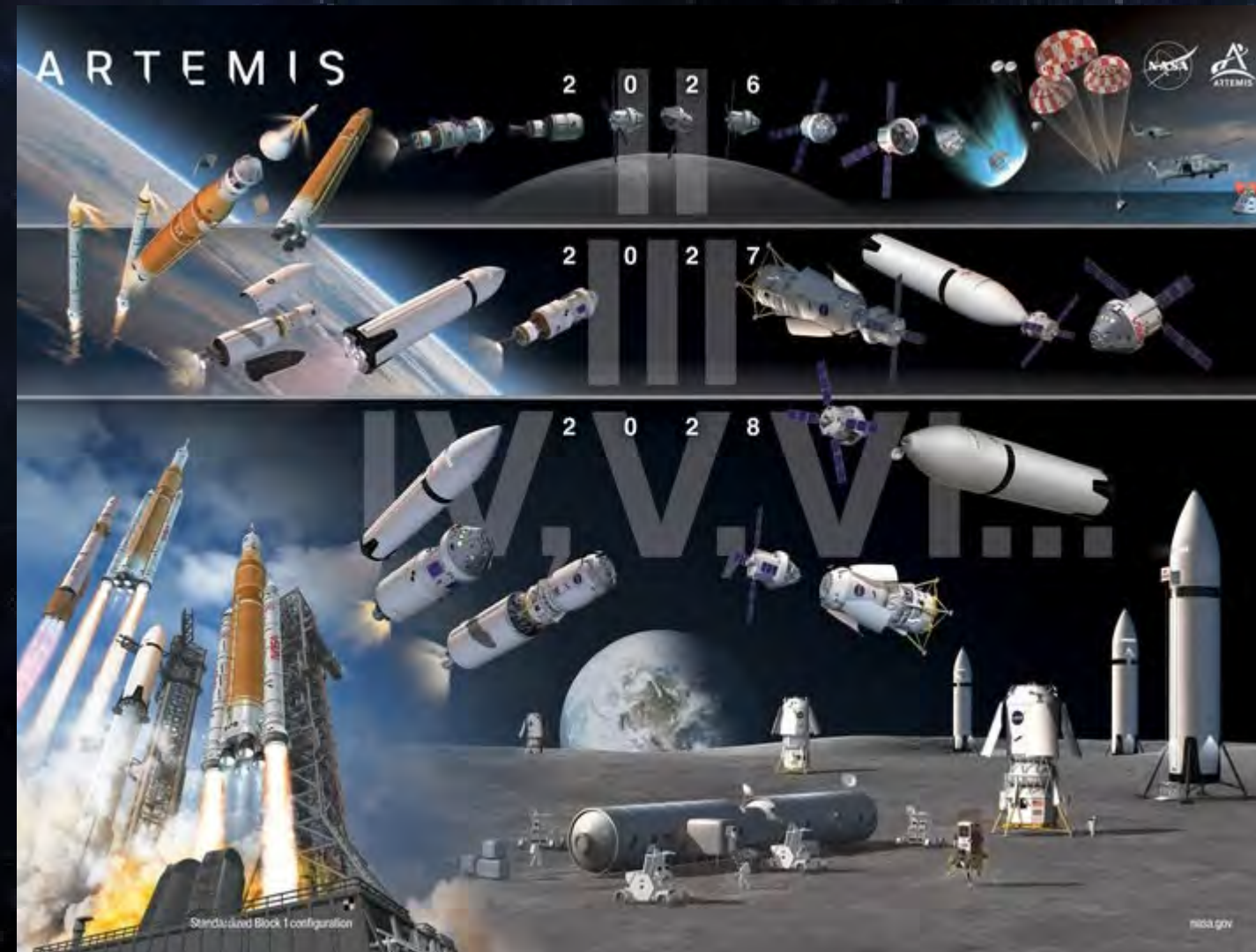
#### Key Highlights:

**Artemis II Launch:** Preparing for a launch soon, this mission will pave the way for future explorations.

**Artemis III Mission (2027):** Designed to test systems and capabilities in low Earth orbit, setting the stage for an Artemis IV landing in 2028. Activities include docking with commercial landers from SpaceX and Blue Origin, testing life support, communication, propulsion systems, and new suits.

NASA Administrator Jared Isaacman emphasized the importance of standardizing vehicle configurations and increasing flight rates safely. Drawing inspiration from Apollo, NASA is taking a phased approach to achieve these ambitious goals.

Boeing is ready to meet increased production demands with their SLS core stage, ensuring safe transport of astronauts directly to the Moon in a single launch.



## Jared Isaacman, NASA Administrator, Talks To Nation

"The SLS is the most advanced manned rocket ever developed by NASA, designed to return American astronauts to the Moon. Despite what was ultimately a successful uncrewed launch in November 2022, the Artemis I campaign experienced many of the same difficulties we are once again observing.

Flying a vehicle this important and complex approximately once every three years is unprecedented across NASA programs and is not compatible with mission success.

We lose experienced talent and institutional operational muscle memory, and we put ourselves in a position where we are relearning lessons with each campaign.

We will invest to pull forward hardware and implement a more regular flight rate. To that end, we will launch Artemis III in 2027 with a new mission profile. This flight will travel to low Earth orbit, exercise Orion alongside one or both landers in LEO and ideally test the lunar EVA suit. In doing so, we will establish a faster test cadence and build confidence in hardware and operations necessary for future Artemis missions.

Implementing my prior workforce directive and rebuilding core competencies in our civil servant workforce will permit faster turnaround of Mobile Launcher 1, positioning NASA for potentially two SLS launches in 2028.

In recent times at NASA, we have attempted to skip the evolutionary steps required to achieve extraordinary outcomes, compressing too much into a single leap. That is not how we succeeded in the 1960s, when Apollo 7 and Apollo 8 launched just 9 weeks apart, and it is not how we will succeed now."

This new approach mirrors that of NASA's early Apollo program, which launched incremental, quick-succession missions to test and prove the technologies necessary to safely land astronauts on the Moon.

## Launch Window

It's all about orbital mechanics and the specific requirements of the mission and its hardware.

Artemis 2 will lift off from Kennedy Space Center for a 10-day trip around the Moon.

But the astronauts won't head directly to lunar realms: Artemis 2's Space Launch System rocket will first deliver Orion to high Earth orbit, where the crew and ground teams will conduct a variety of checkouts to make sure the capsule is ready for its epic journey.

Therefore, "the launch day and time must allow SLS to be able to deliver Orion" to that orbit, according to NASA officials.

"Orion also must be in the proper alignment with the Earth and Moon at the time of the trans-lunar injection burn," they added. That maneuver will put Orion on course for the Moon, which it will fly by on a "free return" trajectory. The capsule will use lunar gravity to slingshot itself back toward Earth, without the need for another significant engine burn.

Orion's power requirements further constrain the mission's launch window.

According to NASA "The trajectory for a given day must ensure Orion is not in darkness for more than 90 minutes at a time so that the solar array wings can receive and convert sunlight to electricity, and the spacecraft can maintain an optimal temperature range," NASA officials wrote. "Mission planners eliminate potential launch dates that would send Orion into extended eclipses during the flight."

## NASA Is Targeting April for the First Crewed Artemis Moon Mission

### NASA Is Targeting April for the First Crewed Artemis Moon Mission

After delays earlier this year, NASA is now aiming for new launch opportunities for Artemis II — the mission that will send astronauts around the Moon for the first time since Apollo 17.

#### 🌙 Key Launch Windows (April 2026)

- April 1
- April 3
- April 4
- April 5
- April 6
- April 30

These dates are determined by orbital mechanics, allowing the spacecraft to follow the correct path for its ~10-day journey around the Moon.

#### 🧠 Why are launch windows so limited?

For Artemis II, several conditions must align:

- 🌙 Precise alignment with the Moon
- 🌞 Proper lighting so astronauts can inspect the spacecraft after launch
- 🌍 Correct trajectory for a safe return to Earth

The mission will lift off from Kennedy Space Center Launch Complex 39B — the same historic pad used for many Apollo program missions.

Artemis II will mark the first time humans travel beyond low-Earth orbit in 54 years.

Credit: NASA/Cory Huston

March 3, 2026

NASA repaired the Artemis II rocket for an April launch

NASA's Artemis II rocket rolls back to the Vehicle Assembly Building for repairs on Feb. 25, 2026. (Image credit: NASA/John Kraus)



NASA successfully repaired its Artemis II rocket, apparently keeping things on track for an April launch of the first crewed Moon mission in 54 years.

Engineers made a fix that aims to restore consistent helium flow to the upper stage of Artemis 2's Space Launch System (SLS) rocket, agency officials announced in an update on Tuesday, March 3.

“ NASA noticed an interruption in helium flow in the SLS' upper stage. That was a significant issue, because helium pressurizes the rocket's propellant tanks. Rollback was the only option, as the affected area in the upper stage was not accessible at the pad.

That work centered on a seal in an interface through which helium flows from ground equipment into the SLS upper stage. That seal was obstructing the interface, which is known as a quick disconnect.

"The team removed the quick disconnect, reassembled the system, and began validating the repairs to the upper stage by running a reduced flow rate of helium through the mechanism to ensure the issue was resolved," NASA officials wrote in the March update. "Engineers are assessing what allowed the seal to become dislodged to prevent the issue from recurring."

The crew of NASA's Artemis II mission (left to right): NASA astronaut Christina Hammock Koch, Reid Wiseman (seated), Victor Glover, and Canadian Space Agency astronaut Jeremy Hansen.

It is the first crewed mission aboard NASA's Space Launch System rocket. The approximately 10-day mission will test and stress the Orion spacecraft's life-support systems to prove the capabilities and techniques required to live and work in deep space in ways only humans can do. Artemis II is the first crewed flight test on the agency's path to establishing a long-term scientific and human presence on the lunar surface.

The crew will include three NASA astronauts and one CSA astronaut.



Christina Koch will become the first woman ever to travel beyond low Earth orbit and circle the Moon. With nearly a year spent in space and multiple record setting spacewalks, she brings extensive experience to this milestone mission. Her participation reflects expanding opportunities and representation in modern space exploration.

Artemis II will test systems needed for future lunar landings and long-duration missions. The mission lays essential groundwork for returning astronauts to the Moon and eventually advancing human exploration toward Mars.

Source: NASA Artemis program mission briefings and official exploration plans.



## Radiation

In free space, radiation exposure is around 700 times greater than on the surface of the Earth. The farther you fly into space, the weaker the protective effect of the earth's atmosphere and earth's magnetic field becomes. As NASA leads the way for human exploration at the Moon and beyond, space radiation is one of the biggest hazards crews face.

To support Artemis II, there has been a sharpening of space weather forecasting skills — an ability to better gauge the sun's activity and to help assure crew safety if a hazardous uptick in solar action rears its energetic head.

The astronauts are protected from deep-space radiation primarily by the Orion spacecraft's designed shielding, which includes, as noted by the European Space Agency, a dedicated "storm shelter" under the floor using stowed gear, food, and water to block solar particles. Furthermore, NASA monitors space weather 24/7 and can reorient the spacecraft to minimize exposure.

## NASA's Artemis II Moon Mission Agenda

About eight minutes after Artemis II lifts off, the Orion spacecraft and its crew, NASA astronauts Reid Wiseman, Victor Glover, and Christina Koch, along with CSA (Canadian Space Agency) astronaut Jeremy Hansen, will be in space. The approximately 10-day test flight will be packed with activity as the astronauts venture around the Moon and back, with teams checking out Orion's systems along the way. While teams in mission control could refine the crew's schedule each day based on operational activities during the test flight, ground teams and the crew have a general plan for each day of the mission.

### **Phase 1: The high Earth orbit "check-out"**

Immediately after the SLS rocket's core stage separates, the crew won't head for the Moon just yet. Instead, they will spend their first 24 hours in a High Earth Orbit.

This is a safety-first approach designed to keep the astronauts close to home while they ensure Orion's life-support systems—like the potable water dispenser and the carbon dioxide scrubbing system—are working perfectly.

During this phase, Pilot Victor Glover will perform a Proximity Operations demonstration. He will manually fly Orion near the spent upper stage of the rocket (the ICPS), practicing the delicate maneuvers and formation flying that future missions will need when docking with the Gateway space station or the SpaceX Starship landing system.

### **Phase 2: The Trans-Lunar Injection (TLI)**

Once NASA is confident that Orion is a healthy ship, the crew will fire the engine one final time to break free of Earth's gravity. This is the Trans-Lunar Injection.

This burn will set them on a free-return trajectory. This is a brilliant bit of orbital mechanics: the path is

# NASA's Artemis II Moon Mission Agenda

## **Phase 3: Farther than any human in history**

On Flight Day 6, the crew will reach the Moon. Unlike the Apollo missions, which went into a low orbit just 60 miles above the surface, Artemis II will perform a high-altitude flyby.

They will pass approximately 4,600 miles beyond the lunar far side. At this apex, the crew will likely break the all-time record for the farthest humans have ever traveled from Earth—surpassing the record set by the Apollo 13 crew in 1970.

From this vantage point, they will be able to see the entire disk of the Moon and the Earthrise over the lunar horizon, providing invaluable data on how the spacecraft handles deep-space radiation.

## **Phase 4: The high-speed homecoming**

After swinging around the Moon, Orion will spend about four days falling back toward Earth, accelerating the entire way. By the time the capsule hits our atmosphere on April 10, it will be traveling at 25,000 mph.

The mission concludes with a skip reentry—where the capsule essentially bounces off the atmosphere like a stone on a pond to dissipate heat—before deploying 11 parachutes for a precision splashdown in the Pacific Ocean.

Only after the U.S. Navy recovers the crew will the mission be declared a total success, paving the way for the Artemis III landing in the years to come.

# What's On The Menu?

## ARTEMIS II CREW MENU



### 189 UNIQUE MENU ITEMS

#### MORE THAN 10 TYPES OF BEVERAGES

- Coffee
- Green Tea
- Mango-Peach Smoothie
- Chocolate Breakfast Drink
- Vanilla Breakfast Drink
- Lemonade
- Apple Cider
- Pineapple Drink
- Cocoa
- Strawberry Breakfast Drink

#### MOST COMMON FOOD ITEMS

- Tortillas
- Wheat Flat Bread
- Vegetable Quiche
- Breakfast Sausage
- Couscous w/ Nuts
- Mango Salad
- Granola w/ Blueberries
- Almonds
- Cashews
- Barbecued Beef Brisket
- Broccoli au Gratin
- Spicy Green Beans
- Macaroni & Cheese
- Tropical Fruit Salad
- Butternut Squash
- Cauliflower

### ARTEMIS II SPICE LEVEL



There are 5 different hot sauces flying around the Moon with the crew.

### HOW MANY CUPS OF COFFEE DOES IT TAKE TO POWER THE ARTEMIS II CREW?



### CULINARY FLAVORINGS



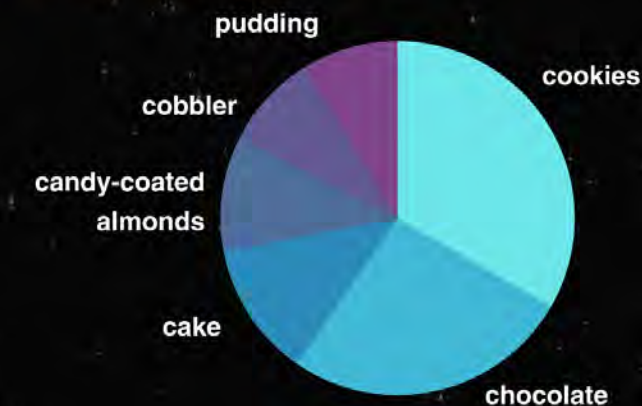
Maple Syrup, Chocolate Spread, Peanut Butter, Hot Sauce, Spicy Mustard, Strawberry Jam, Honey, Cinnamon, Almond Butter



5 CANADIAN PRODUCTS



### WHAT WILL SATISFY THE CREW'S SWEET TOOTH?



# Space Suits



## Moon Regolith

Lunar regolith is a fine, sharp-edged, and chemically reduced layer of loose debris covering the Moon's surface, formed by billions of years of meteorite impacts rather than biological processes.

The fine lunar regolith is made of sharp and very adhesive particles, with a distinct gunpowder taste and smell.

# The "Bunny Hop"





Apollo



Artemis 3



A prototype for the Axiom Extravehicular Mobility Unit (AxEMU), a spacesuit for use on the Moon designed, built and being furnished to NASA by Axiom Space. (Image credit: collectSPACE.com)



# Revised Strategy

## Beyond Artemis 2: NASA pursuing a 'more achievable' path back to the Moon

The strategy shift comes amid delays to SpaceX's massive Starship rocket, whose upper stage NASA tapped to be the Artemis program's first crewed Moon lander. Under the original architecture, Artemis 3 depended on the completion of several complex milestones that Starship has yet to demonstrate. These include large-scale transfer and storage of super-cooled propellant in space, as well as a dozen or so refueling flights in Earth orbit before the vehicle can head to the moon.

NASA has selected the Blue Moon lander from Blue Origin, which has paused its suborbital space tourism efforts for at least two years to accelerate development of its lunar lander. NASA plans to test the rendezvous and docking capabilities of Orion alongside Starship and/or Blue Moon in Earth orbit during Artemis 3, which is now targeted to launch in 2027.

NASA hopes the revised plan will keep it on track for a lunar landing in 2028, while also positioning the agency to return astronauts to the Moon before China.

The revised strategy places increased emphasis on robotic precursor missions to lay the groundwork for a sustained human presence. NASA envisions a steady cadence of robotic landings near the south pole — potentially as often as monthly — beginning as early as 2027, to gather data on temperature extremes, soil properties and communications challenges.

The data will help reduce risk for future crews and "actually give ourselves a credible shot at aggregating a lunar base in the right spot," Kshatriya said.

## With Gateway likely gone, where will lunar landers rendezvous with Orion?

NASA Administrator Jared Isaacman unveiled a major shakeup in the Artemis Program, intended to put the nation on a better path back to the Moon. The changes focused largely on increasing the launch cadence of NASA's large SLS rocket and putting a greater emphasis on lunar surface activities.

But it neglects a critical element of the Artemis program: a lander capable of taking astronauts down to the lunar surface from an orbit around the Moon and back up to rendezvous with Orion. NASA has contracted with SpaceX and Blue Origin to develop these landers, Starship and Blue Moon MK2, respectively.

As part of his announcement, Isaacman said a revamped Artemis III mission will now be used to test one or both of these landers near Earth before they are called upon to land humans on the Moon later this decade.

NASA will launch Artemis III next year, he said, to be followed by one or possibly even two lunar landings in 2028. A single landing before the end of 2028 seems like a stretch, even for glass-half-full optimists in the space community. And for there to be a chance of happening, SpaceX or Blue Origin, or both, need to get hustling quickly.

To reach the Moon during the initial Artemis missions, a lander must dock with the Orion spacecraft. That may sound routine, as spacecraft have been rendezvousing and docking in space for six decades.

Orion, however, is saddled with thousands of requirements, and virtually every decision point regarding docking must be signed off on by the lander company—SpaceX or Blue Origin—as well as NASA, Orion's contractor Lockheed Martin, and the European service module contractor Airbus. Additionally, Orion has a lot of sensitive elements to work around, such as the plumes of its thrusters, and engineers have spent a lot of time working on issues such as ensuring consistent cabin pressures between vehicles. In short, it gets complicated fast.

## Without Gateway how will lunar landers rendezvous with Orion?

Why not simply have Orion meet the landers in a low-lunar orbit, similar to the Apollo Program? This would allow the landers to consume less propellant on the way down and back up from the Moon.

The reason is that, due to a number of poor decisions over the last 15 years, the Orion spacecraft's service module does not have the performance needed to reach low-lunar orbit and then return safely to Earth.

Perhaps the biggest problem with using Starship as a lander is the need to fly multiple uncrewed tanker missions to refuel Starship in low-Earth orbit before it transits to the Moon and awaits a crew aboard Orion. This necessitates an estimated one- or two-dozen launches.

The best solution NASA could come up with was flying an optimized, expendable Starship tanker stage that would maximize propellant delivery per flight. When asked about this, though, SpaceX founder Elon Musk shot down the idea. Once Starship begins flying at rate, Musk believes, a dozen or more tanker missions per lunar flight will not pose a major impediment.

But SpaceX has not proposed significant changes to its Human Landing System hardware. In response to NASA's desire to accelerate the Artemis timeline, the company has indicated that it will prioritize the Human Landing System more as part of the Starship program. The company also suggested that eliminating the requirement to dock in near-rectilinear halo orbit could open up new mission plans, including potentially docking with Orion in orbit around Earth rather than the Moon.

Blue Origin, founded by Jeff Bezos, has been more responsive. Last October, Ars reported that the company had started working on a faster architecture that would not require orbital refueling. A month later, Blue Origin's chief executive, Dave Limp, said the company "would move heaven and Earth" to help NASA reach the Moon sooner.

Artist's illustration of Starship on the surface of the Moon.  
Credit: SpaceX



Artist's illustration of the Blue Origin lander. (Image credit: Blue Origin)



## NASA pivots to Moon base and nuclear Mars mission

NASA's leaders laid out an ambitious multibillion-dollar space exploration plan that calls for building a moon base over the next decade and launching a nuclear-powered probe to Mars by 2028.

NASA is pausing its multibillion-dollar plan to create a Moon-orbiting outpost, the lunar Gateway, and on its plan for transitioning from the International Space Station to commercial outposts in low Earth orbit.

Instead, NASA says it aims to work with commercial partners to procure a government-owned Core Module for the ISS. That module would serve as the attachment point for commercial space modules that could eventually detach to become free-flying space stations.

The Power and Propulsion Element that was designed for the Gateway would be repurposed for the Mars probe known as Space Reactor-1 Freedom. SR-1 Freedom would be powered by a nuclear electric propulsion system and drop off a payload capable of deploying three helicopters in the Martian atmosphere. Such a mission, known as Skyfall, builds on the success of NASA's Ingenuity helicopter on Mars and parallels a concept proposed last year by AeroVironment.

NASA is aiming to launch SR-1 Freedom, land astronauts on the lunar surface with its Artemis 4 mission and start laying the groundwork for a Moon base with Artemis 5 by the end of 2028.

An artist's conception shows Space Reactor-1 Freedom approaching Mars. (NASA)



# Living And Working On The Moon

Focus on scientific exploration of lunar resources, and prepare the lunar surface for a sustained human presence.

NASA's robotic lunar surface missions will soon begin and will focus on scientific understanding of lunar resources, and prepare the lunar surface for a sustained human presence.

Commercial Lunar Payload Services (CLPS) is one of the first steps toward long-term scientific study and human exploration of the Moon and eventually Mars.



As part of the agency's Artemis campaign, NASA has awarded Blue Origin a task order with an option to deliver a rover to the Moon's South Pole region. NASA's VIPER (Volatiles Investigating Polar Exploration Rover) will search for volatile resources, such as ice, on the lunar surface and collect science data to support future exploration at the Moon and Mars.

This artist's concept shows Blue Origin's Blue Moon Mark 1 lander and NASA's VIPER (Volatiles Investigating Polar Exploration Rover) on the lunar surface.

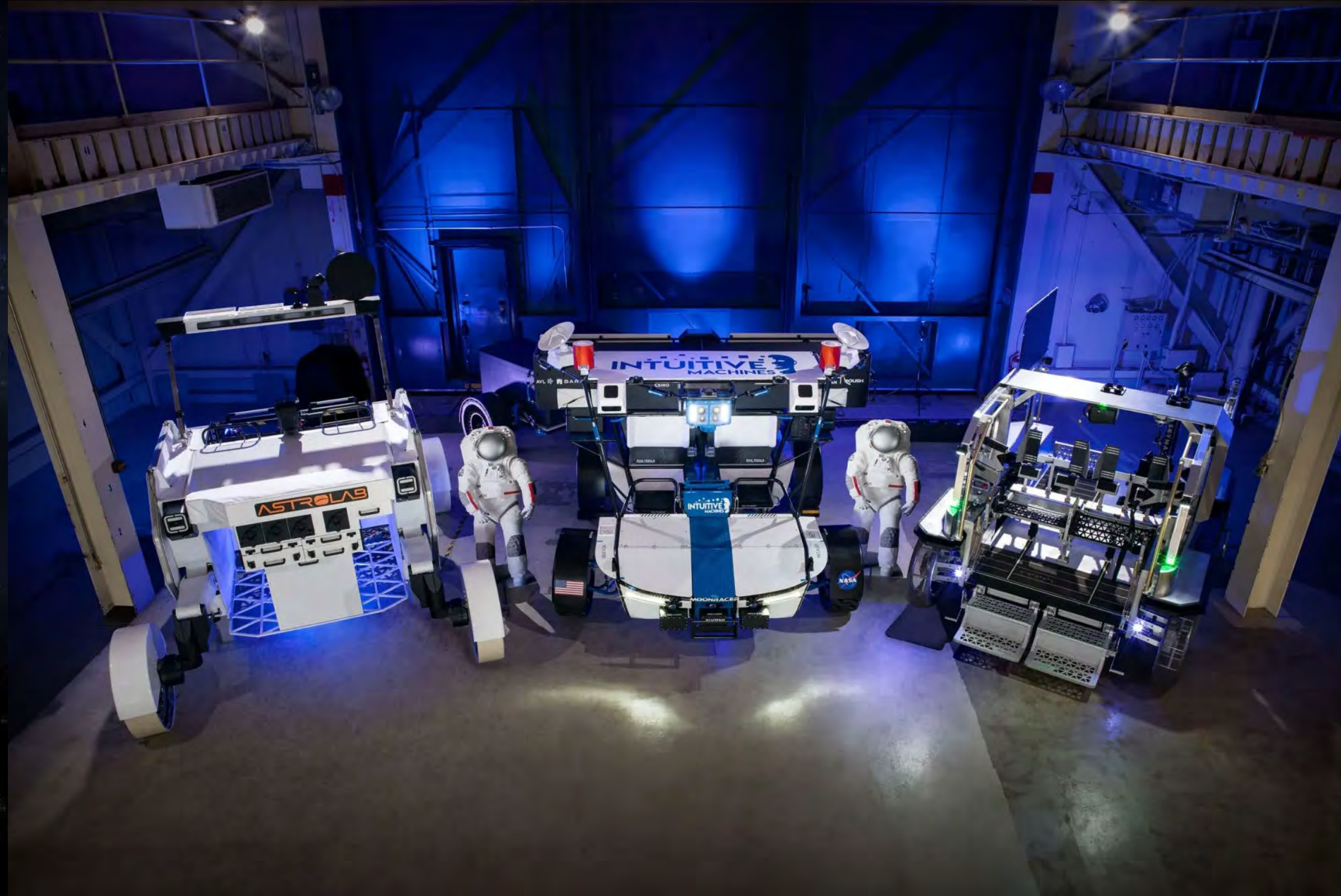
Credit: Blue Origin



## Lunar Rovers

Through NASA's Artemis campaign, astronauts will land on the lunar surface and use a new generation of spacesuits and rovers as they live, work, and conduct science in the Moon's South Pole region, exploring more of the lunar surface than ever before. Recently, the agency completed the first round of testing on three commercially owned and developed LTVs (Lunar Terrain Vehicle) from Intuitive Machines, Lunar Outpost, and Venturi Astrolab at NASA's Johnson Space Center in Houston.

NASA/Bill Stafford



An artist's conception highlights elements of a future Moon base, including inflatable habitats, pressurized rovers, transport ships, drones and connections to power facilities. (NASA Illustration)

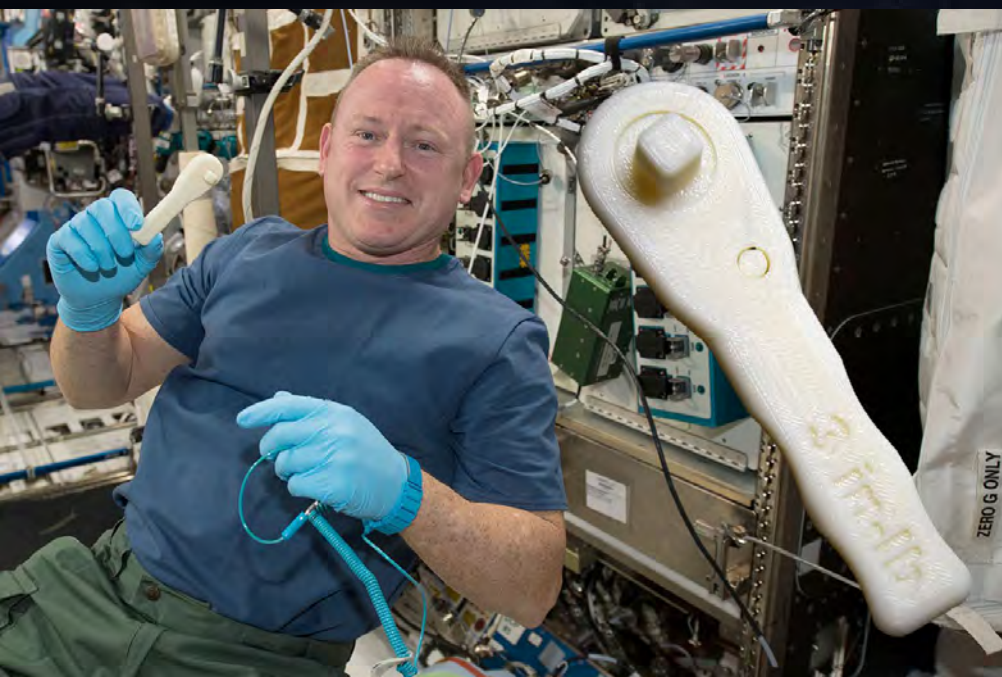


- Pre-made habitats using 3-D printing using:

- Moon regolith

- Mars regolith

- NASA, ESA & ROSCOSMOS



## HOW COULD IT WORK?

At this stage, it's still **guesswork** – most proposals have resembled the Underpants Gnomes' business model:

Phase 1	Phase 2	Phase 3
Go to the moon	?	Minerals

SpaceX is trying to solve the problem of launch costs with reusable rockets – so assuming that works, a hypothetical lunar mining colony might look like this:

### 3D printers



Moon mining requires infrastructure before it can even begin. One solution is to manufacture material on the moon using 3D printers (of course, we'd still need to get the materials up there).

### Helium-3 storage facility



Ferrying vast amounts of lunar soil to Earth for processing is impractical. Gas will be generated on the moon and captured in storage containers.

### Robot miners



Self-sufficient robots that require minimal human oversight will be vital to cost-effective mining operations.

### A lunar base



Given the presence of water on the moon, this opens the potential for a long-term human presence. Printed bases remove the problem of logistics.

### Turning Moon dust into homes

Skyeports has developed a way to transform lunar dust, known as regolith, into durable glass that can be shaped into massive spheres. Using a microwave furnace, the regolith melts and expands like a bubble before cooling into a hard, transparent shell. These spheres could one day serve as living and working spaces for astronauts.

The innovation lies in building directly on the Moon using local materials. No costly shipments from Earth are required. The same pipes used to blow the molten glass will become entrances, while 3D printers inside the spheres will create furniture and fittings using lunar materials.

The planned glass spheres are designed as self-sustaining ecosystems. The glass can repair small cracks caused by micrometeorites or moonquakes, and built-in solar panels will allow each habitat to generate its own energy.

Inside, temperature layers could create condensation to support plant growth. This would produce oxygen, water and food, making each sphere a self-contained life-support system.

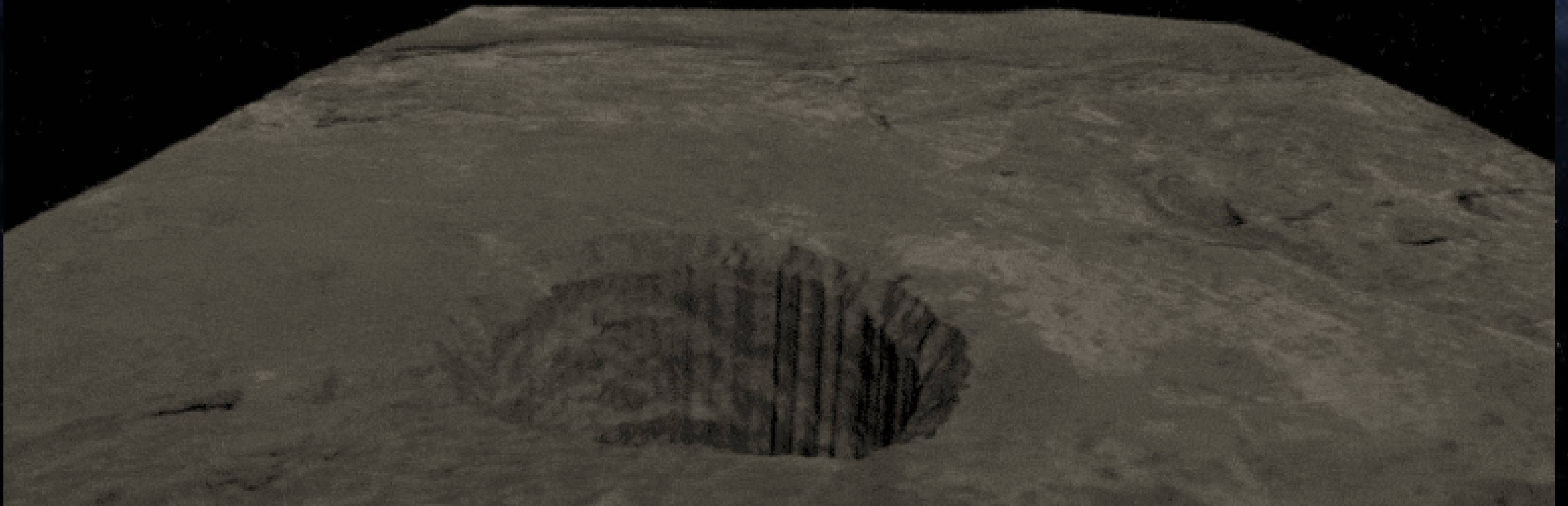
(Image Credit: Skyeports)



August, 2024

Scientists find the 'front door' to a massive cave on the Moon

The Sea of Tranquility is home to at least one lunar lava tube, which could preserve a pristine and unweathered record of lunar volcanism.

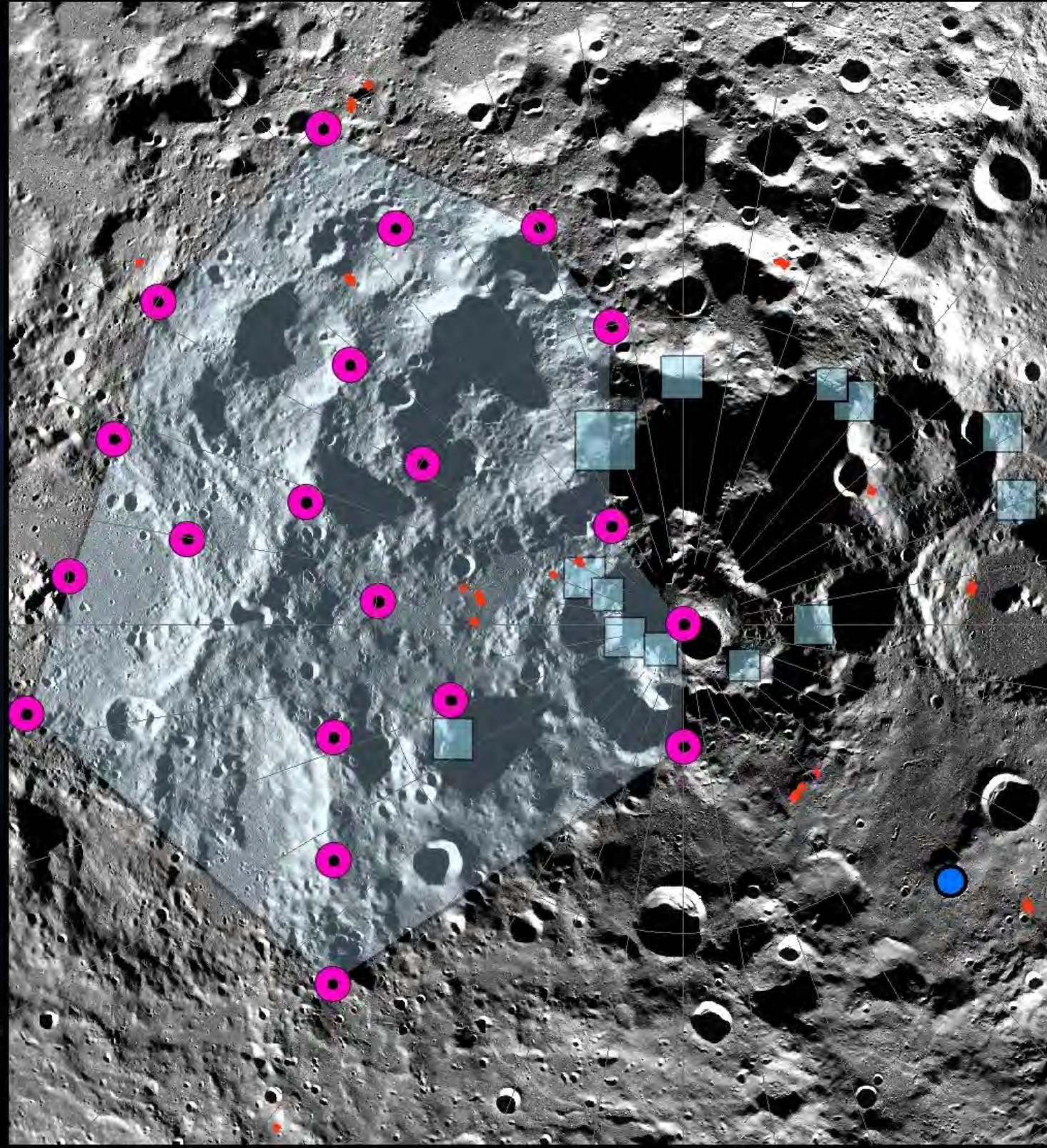


### Shrinking Moon Causing Moonquakes and Faults Near Lunar South Pole

The epicenter of one of the strongest moonquakes recorded by the Apollo Passive Seismic Experiment was located in the lunar south polar region. Scarps are cliff-like landforms that resemble small stair-steps on the lunar surface. They form where contractional forces break the crust and push or thrust it on one side of the fault up and over the other side. The contraction is caused by cooling of the Moon's still-hot interior and tidal forces exerted by Earth, resulting in the Moon shrinking.

Diagram of lunar fault formation process.

A cloud of possible locations (magenta dots and light blue polygon) of the strong shallow Moonquakes



## Setting Time On The Moon:

Space organizations have started considering how to keep time on the Moon.

The ESA is developing through its Moonlight program a lunar communications and navigation service to enable missions to maintain links to and from Earth, and guide them on their way around the Moon and on the surface.

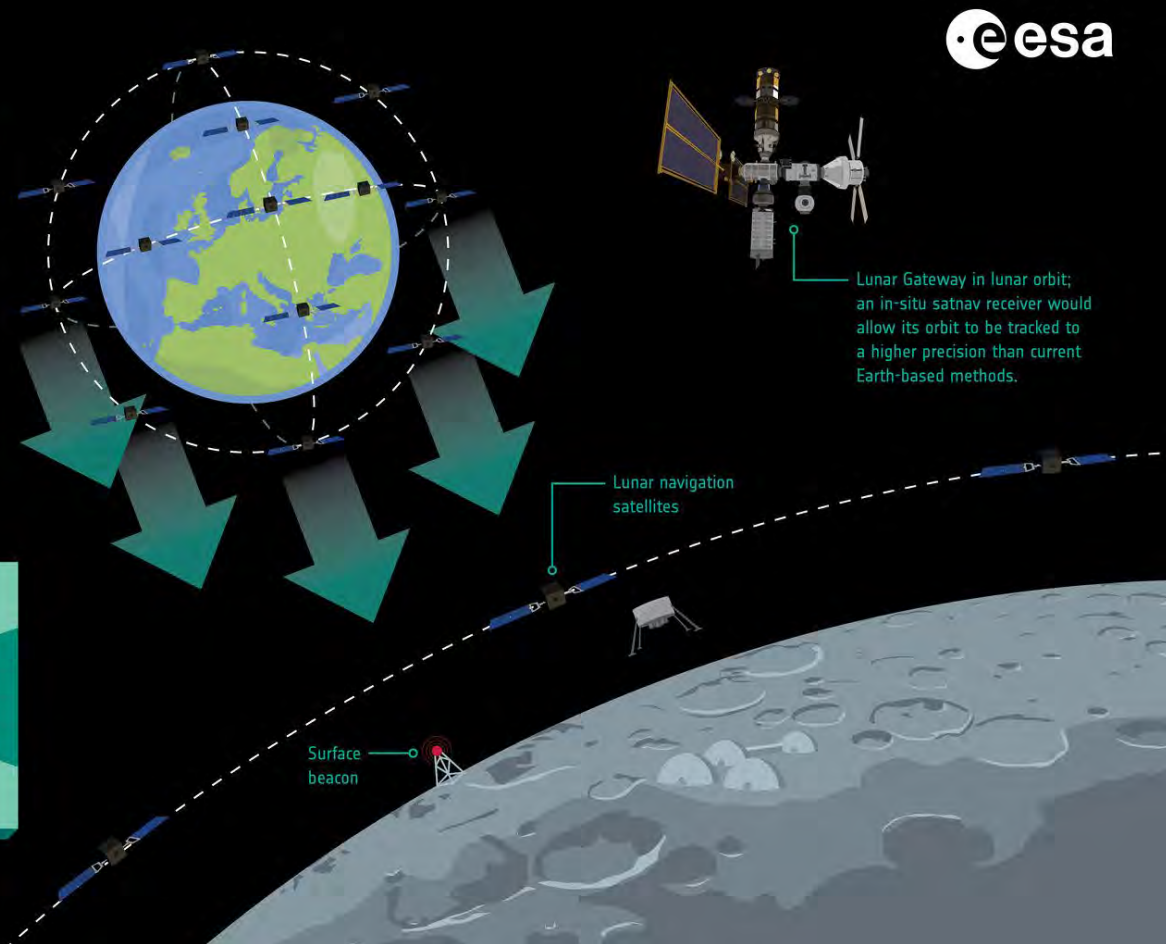
### MOONLIGHT

#### Navigation and Telecommunications for the Moon

ESA's Moonlight initiative involves expanding satnav coverage and communication links to the Moon. The first stage involves demonstrating the use of current satnav signals around the Moon. This will be achieved with the Lunar Pathfinder satellite in 2024. The main challenge will be overcoming the limited geometry of satnav signals all coming from the same part of the sky, along with the low signal power. To overcome that limitation, the second stage, the core of the Moonlight system, will see dedicated lunar navigation satellites and lunar surface beacons providing additional ranging sources and extended coverage.

Navigation satellites like Europe's Galileo constellation radiate most of the energy of their navigation antennas directly towards the Earth disc, blocking their use for users further away in space. But navigation signal patterns also radiate sideways, like light from a flashlight, these antenna 'side lobes' can be employed for positioning all the way to the Moon.

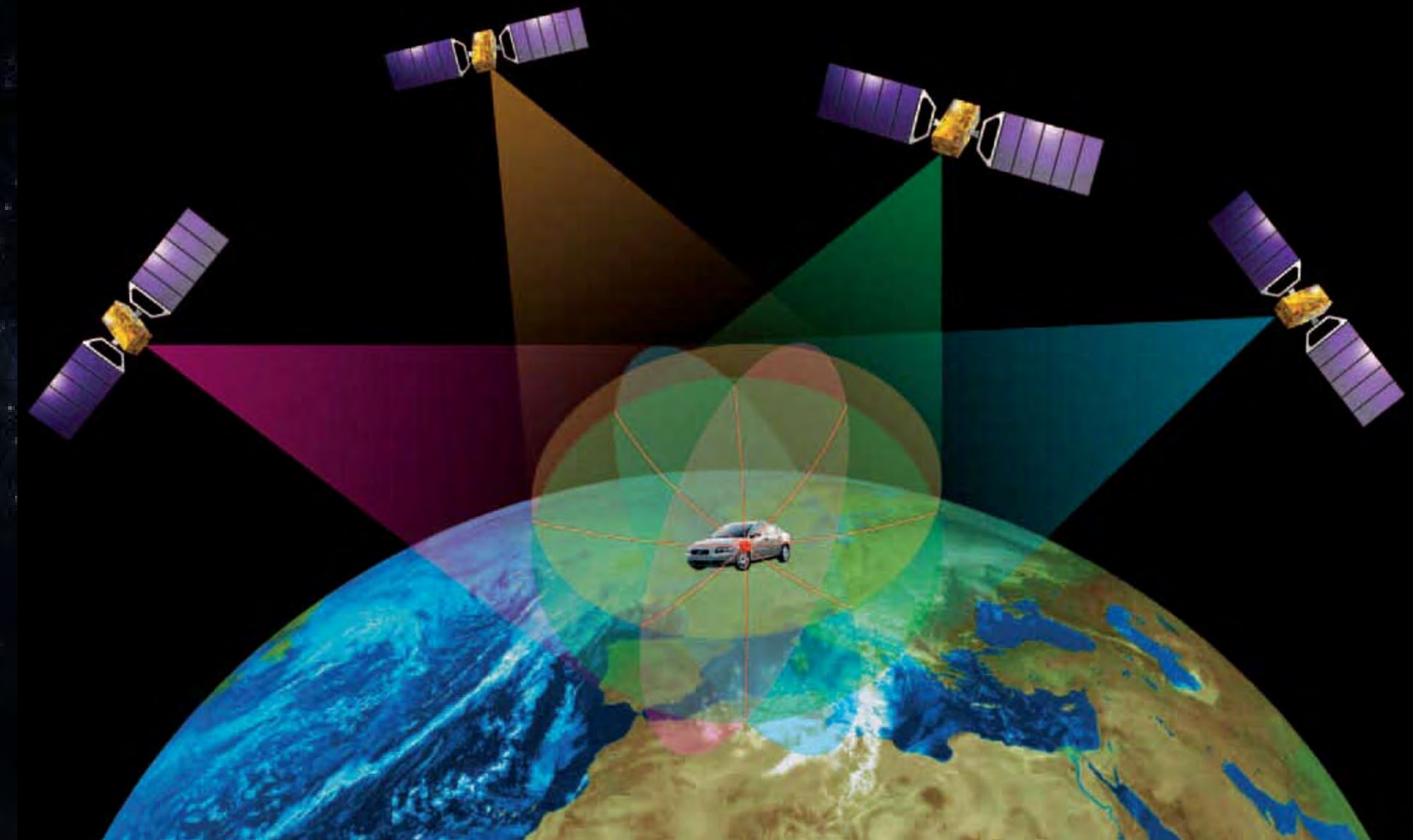
#Moonlight



Lunar Gateway in lunar orbit; an in-situ satnav receiver would allow its orbit to be tracked to a higher precision than current Earth-based methods.

Lunar navigation satellites

Surface beacon



# Why Return to the Moon?

- To learn what it takes to become a space-faring civilization
- As a stepping stone to what is beyond
- Learn how to establish permanent presence
- Learn to collect materials needed to go forward, rather than return to Earth for supplies
- To learn more about the Moon and the early Solar System
- Helium 3
- We've only explored 6% of the Moon's surface!
- NASA created a Moon to Mars office.
- Artemis II: Late 2024
- Targeted human return date: 2025



## Want to track the Artemis II crew around the Moon like Mission Control?

NASA invites the public to follow the Artemis II mission as a crew of four astronauts venture around the Moon inside the agency's Orion spacecraft, people around the world can pinpoint Orion during its journey using the Artemis Real-time Orbit Website (AROW).

Anyone with internet access can track where Orion and the crew are, including their distance from Earth, distance from the Moon, mission duration, and more. Access to AROW is available on:

**NASA's website ([www.nasa.gov/trackartemis](http://www.nasa.gov/trackartemis))**

**The NASA app ([www.nasa.gov/nasa-app](http://www.nasa.gov/nasa-app))**

Using AROW, the public can visualize data that is collected by sensors on Orion and then sent to the Mission Control Center at NASA's Johnson Space Center in Houston during its flight. It will provide constant information using this real-time data beginning about one minute after liftoff through Orion's atmospheric reentry to Earth at the end of the mission.



THANK YOU!

