



November 17, 2023

**NASA Advisory Council**

# ARTEMIS

## **Moon to Mars Overview and Status**

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# Outline



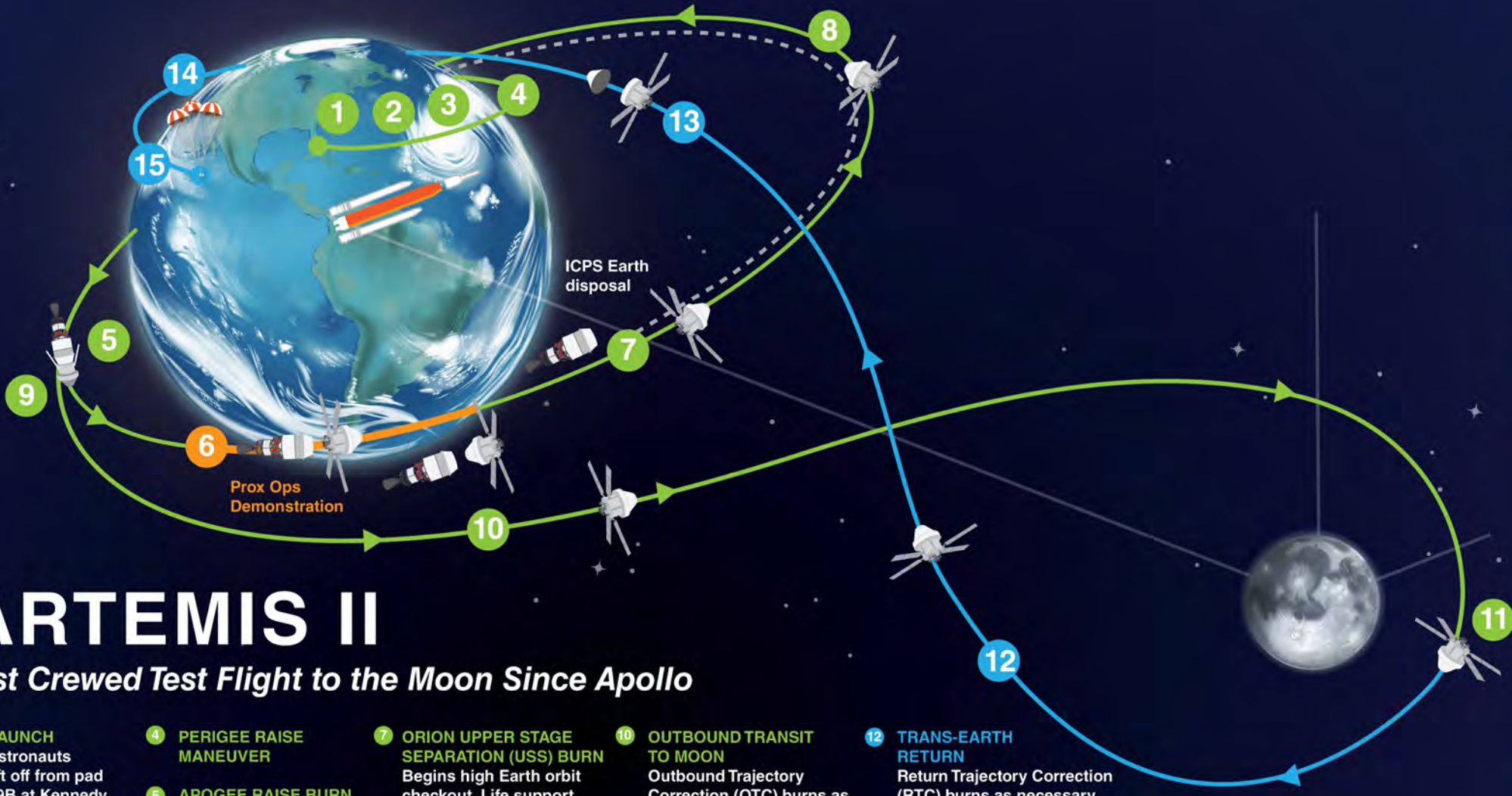
- Artemis II Mission Status
- Artemis III Mission Status
- Artemis IV Mission Status
- Artemis V Mission Status
- Mars Campaign Office – Mars Risk Reduction Through Artemis



# ARTEMIS

Artemis II Mission Status





# ARTEMIS II

## First Crewed Test Flight to the Moon Since Apollo

- 1 LAUNCH**  
Astronauts lift off from pad 39B at Kennedy Space Center.
- 2 JETTISON SOLID ROCKET BOOSTERS, FAIRINGS, AND LAUNCH ABORT SYSTEM**  
Core stage main engine cut off with separation.
- 3 CORE STAGE MAIN ENGINE CUT OFF**  
With separation.
- 4 PERIGEE RAISE MANEUVER**
- 5 APOGEE RAISE BURN TO HIGH EARTH ORBIT**  
Begin 23.5 hour checkout of spacecraft.
- 6 ORION SEPARATION FROM INTERIM CRYOGENIC PROPULSION STAGE (ICPS) FOLLOWED BY PROX OPS DEMO**  
Plus manual handling qualities assessment for up to 2 hours.
- 7 ORION UPPER STAGE SEPARATION (USS) BURN**  
Begins high Earth orbit checkout. Life support, exercise, and habitation equipment evaluations.
- 8 PERIGEE RAISE BURN**
- 9 TRANS-LUNAR INJECTION (TLI) BY ORION'S MAIN ENGINE**  
Lunar free return trajectory initiated with European service module.
- 10 OUTBOUND TRANSIT TO MOON**  
Outbound Trajectory Correction (OTC) burns as necessary for Lunar free return trajectory; travel time approximately 4 days.
- 11 LUNAR FLYBY**  
6,479 miles / 10,427 km (mean) lunar farside altitude.
- 12 TRANS-EARTH RETURN**  
Return Trajectory Correction (RTC) burns as necessary to aim for Earth's atmosphere; travel time approximately 4 days.
- 13 CREW MODULE SEPARATION FROM SERVICE MODULE**
- 14 ENTRY INTERFACE (EI)**  
Enter Earth's atmosphere.
- 15 SPLASHDOWN**  
Ship recovers astronauts and capsule.

PROXIMITY OPERATIONS DEMONSTRATION SEQUENCE	
1	9
2	10
3	11
4	12
5	13
6	14
7	15
8	16
	17



# Artemis II Mission Status



## Mission

- Artemis II integrated testing, mission simulations, and training have begun.
- Artemis II crew training is underway.

## Orion

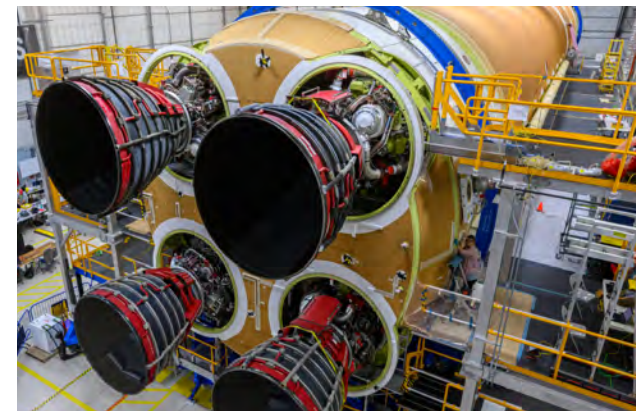
- Artemis II Crew Module (CM) and Service Module (SM) integration was completed, forming the Crew and Service Module (CSM).
- CSM Initial Power On (IPO) completed. After functional tests are complete, altitude chamber testing will begin, which will put the spacecraft through conditions as close as possible to the environment it will experience in the vacuum of deep space.

## SLS

- Artemis II hardware is or will be complete in 2023 and ready for delivery to EGS with positive margins to handover dates. Block 1 crew delta Design Certification Review (DCR) planned for early 2024.
- Core Stage is fully mated and is in final integration and test at Michoud Assembly Facility (MAF). All four engines have been installed. Completing remaining integration and assembly activities to support a delivery of the Artemis II Core Stage to KSC in early 2024.
- Interim Cryogenic Propulsion Stage (ICPS) is complete and in storage at the United Launch Alliance (ULA) facilities at the Cape and ready for delivery to EGS. Launch Vehicle Stage Adaptor (LVSA) is also complete and ready for delivery.
- All solid rocket motor segments, nozzle aft exit cones, and aft skirts for Artemis II have been delivered to KSC and flight processing has begun.

## EGS

- Mobile Launcher 1 refurbishment is still on track to support Artemis II processing.
- Artemis II modifications (Crew Access Arm, Emergency Egress System, Environmental Control System in the Vertical Assembly Building and at the pad, and new 1.4-million-gallon liquid hydrogen sphere) continue and are nearing completion.

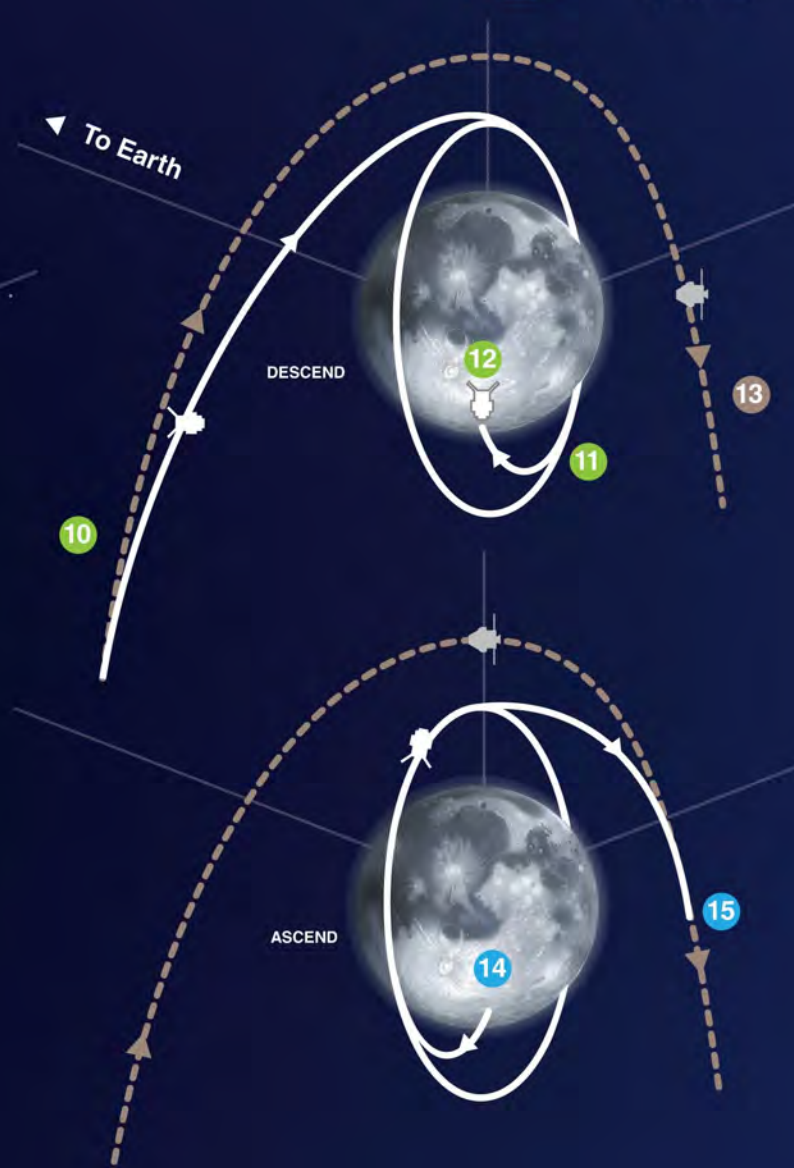
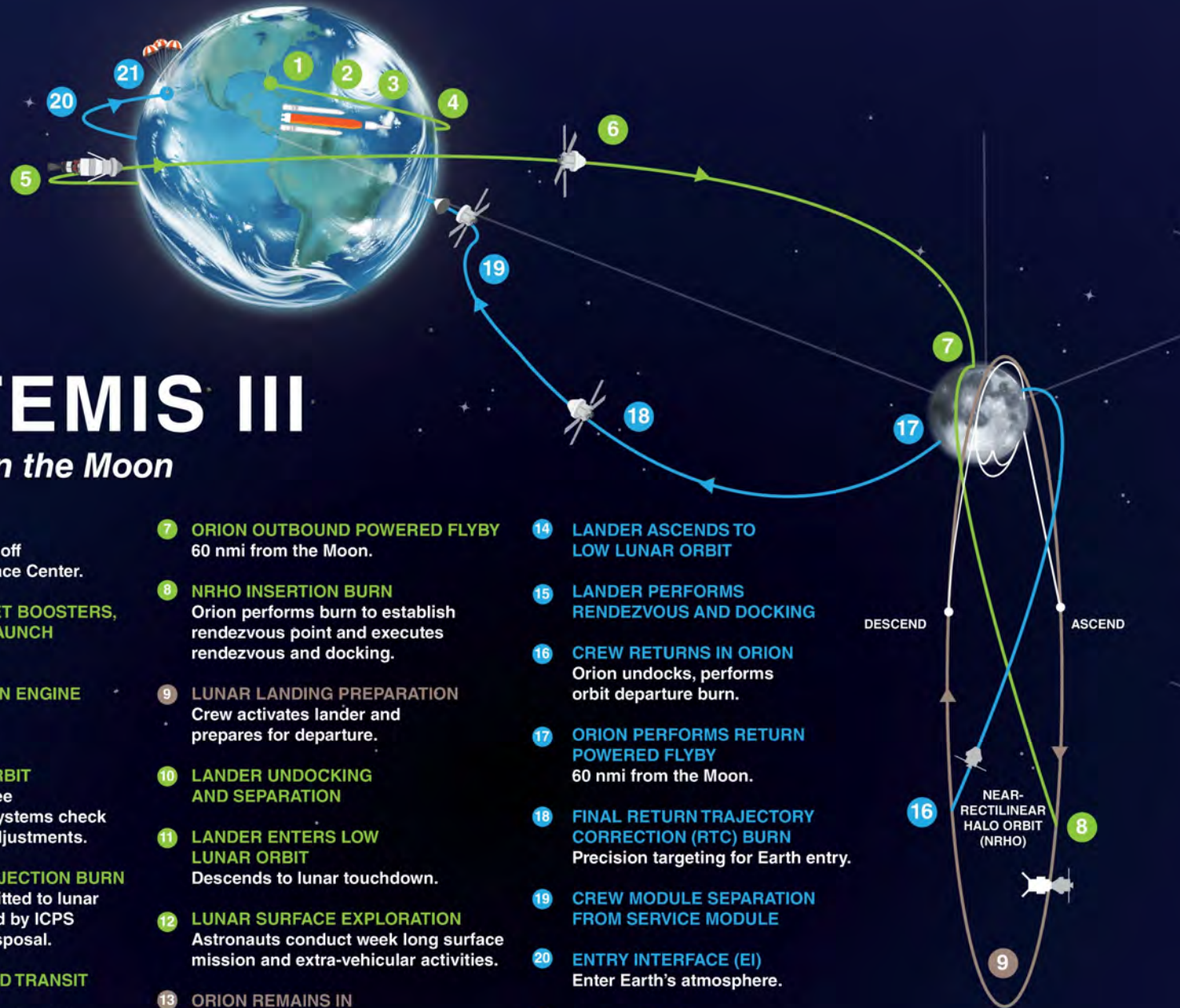




# ARTEMIS

Artemis III Mission Status





# ARTEMIS III

## Landing on the Moon

- 1 LAUNCH**  
SLS and Orion lift off from Kennedy Space Center.
- 2 JETTISON ROCKET BOOSTERS, FAIRINGS, AND LAUNCH ABORT SYSTEM**
- 3 CORE STAGE MAIN ENGINE CUT OFF**  
With separation.
- 4 ENTER EARTH ORBIT**  
Perform the perigee raise maneuver. Systems check and solar panel adjustments.
- 5 TRANS LUNAR INJECTION BURN**  
Astronauts committed to lunar trajectory, followed by ICPS separation and disposal.
- 6 ORION OUTBOUND TRANSIT TO MOON**  
Requires several outbound trajectory burns.
- 7 ORION OUTBOUND POWERED FLYBY**  
60 nmi from the Moon.
- 8 NRHO INSERTION BURN**  
Orion performs burn to establish rendezvous point and executes rendezvous and docking.
- 9 LUNAR LANDING PREPARATION**  
Crew activates lander and prepares for departure.
- 10 LANDER UNDOCKING AND SEPARATION**
- 11 LANDER ENTERS LOW LUNAR ORBIT**  
Descends to lunar touchdown.
- 12 LUNAR SURFACE EXPLORATION**  
Astronauts conduct week long surface mission and extra-vehicular activities.
- 13 ORION REMAINS IN NRHO ORBIT**  
During lunar surface mission.
- 14 LANDER ASCENDS TO LOW LUNAR ORBIT**
- 15 LANDER PERFORMS RENDEZVOUS AND DOCKING**
- 16 CREW RETURNS IN ORION**  
Orion undocks, performs orbit departure burn.
- 17 ORION PERFORMS RETURN POWERED FLYBY**  
60 nmi from the Moon.
- 18 FINAL RETURN TRAJECTORY CORRECTION (RTC) BURN**  
Precision targeting for Earth entry.
- 19 CREW MODULE SEPARATION FROM SERVICE MODULE**
- 20 ENTRY INTERFACE (EI)**  
Enter Earth's atmosphere.
- 21 SPLASHDOWN**  
Ship recovers astronauts and capsule.



# Artemis III Mission Status



## Mission, Science, and Utilization

- Artemis III mission specific requirements baselined.
- Geology team selected by Science Mission Directorate (SMD) for first crewed lunar landing.

## Orion

- Artemis III build in progress and various testing underway; first build under Orion Production & Operations Contract (OPOC).
- Service Module integration in progress in Bremen, Germany.
- NASA Docking System (NDS Block 2) build in progress.

## SLS

- All Artemis III hardware is in manufacturing flow with completion and readiness for delivery to EGS beginning in 2024 through early 2025.
- ICPS transferred to the ULA Delta Operations Center test cell, forecasted completion of testing and checkout in December 2023. LVSA, and Orion Stage Adaptor (OSA) scheduled to be complete in 2024.
- Core Stage III scheduled to be complete in 2025 and the engine section work is in progress at the KSC Space Station Processing Facility. All core stage engines are in storage at SSC.
- All solid rocket motor segments for Artemis III have been cast and are in storage in Utah.

## EGS

- No significant changes planned for Artemis III.

## HLS

- Successful ground test of Gaseous Propulsion System Module.
- Completed preliminary definition of Starship training operations & systems plans.
- Second Starship/Super Heavy flight test planned for November 2023. (FAA license expected before November 30, 2023)

## EHP

- Initial safety review for Axiom suits and tools under way.
- Pressurized suit tests (1-g) in progress with flight crew office test subjects.



Credit: SpaceX





# ARTEMIS

Artemis IV Mission Status



# ARTEMIS IV

*International Habitation Module delivery to Gateway followed by Crewed Lunar Landing*



## 1 LAUNCH

SLS with I-HAB co-manifested payload and Orion with 4 crew members lift-off from Kennedy Space Center.

## 2 JETTISON ROCKET BOOSTERS, FAIRINGS, AND LAUNCH ABORT SYSTEM

## 3 CORE STAGE MAIN ENGINE CUT OFF

With separation.

## 4 ENTER EARTH ORBIT

Exploration Upper Stage (EUS) performs circularization of Low Earth Orbit. Systems check and solar panel adjustments.

## 5 TRANS LUNAR INJECTION BURN

EUS commits astronauts in Orion and I-HAB to lunar trajectory.

## 6 ORION TUGS I-HAB TO MOON

Orion separation from Universal Stage Adapter (USA), ejection of USA, Orion docking with I-HAB for extraction from EUS/ Payload Adapter Fitting (PAF) followed by Orion tug of I-HAB to Gateway Orbit and EUS disposal.

## 7 ORION OUTBOUND TRANSIT TO MOON

Requires several outbound trajectory burns.

## 8 ORION OUTBOUND POWERED FLYBY

60 nmi from the Moon.

## 9 GATEWAY ORBIT INSERTION BURN

Orion performs burn to establish rendezvous point and executes rendezvous and docking.

## 10 INTERNATIONAL HABITATION MODULE ARRIVAL AT GATEWAY

I-HAB docking with Orion to Power and Propulsion Element (PPE) and Habitation and Logistic Outpost (HALO) module.

## 11 I-HAB ACTIVATION AND CREW INGRESS

Astronauts ingress, activate and utilize I-HAB as part of larger Gateway complex.

## 12 LUNAR LANDING PREPARATION

Crew activates Lander and prepares for departure.

## 13 LANDER UNDOCKING AND SEPARATION

## 14 LANDER ENTERS LOW LUNAR ORBIT

Two astronauts descent to lunar touchdown.

## 15 LUNAR SURFACE EXPLORATION

Astronauts conduct week long surface mission including moon walks, rover ops, and surface science.

## 16 ORION REMAINS IN LUNAR GATEWAY ORBIT

Other two astronauts tend to Gateway during lunar surface mission.

## 17 LANDER ASCENDS TO LOW LUNAR ORBIT

## 18 LANDER PERFORMS RENDEZVOUS AND DOCKING

## 19 CREW RETURNS IN GATEWAY / ORION

Crew transfers science samples to Orion for return, undocks, performs departure burn.

## 20 ORION PERFORMS RETURN POWERED FLYBY

Lunar gravity assist, fly 60 nmi from the Moon.

## 21 FINAL RETURN TRAJECTORY CORRECTION BURN

Precision targeting for Earth entry.

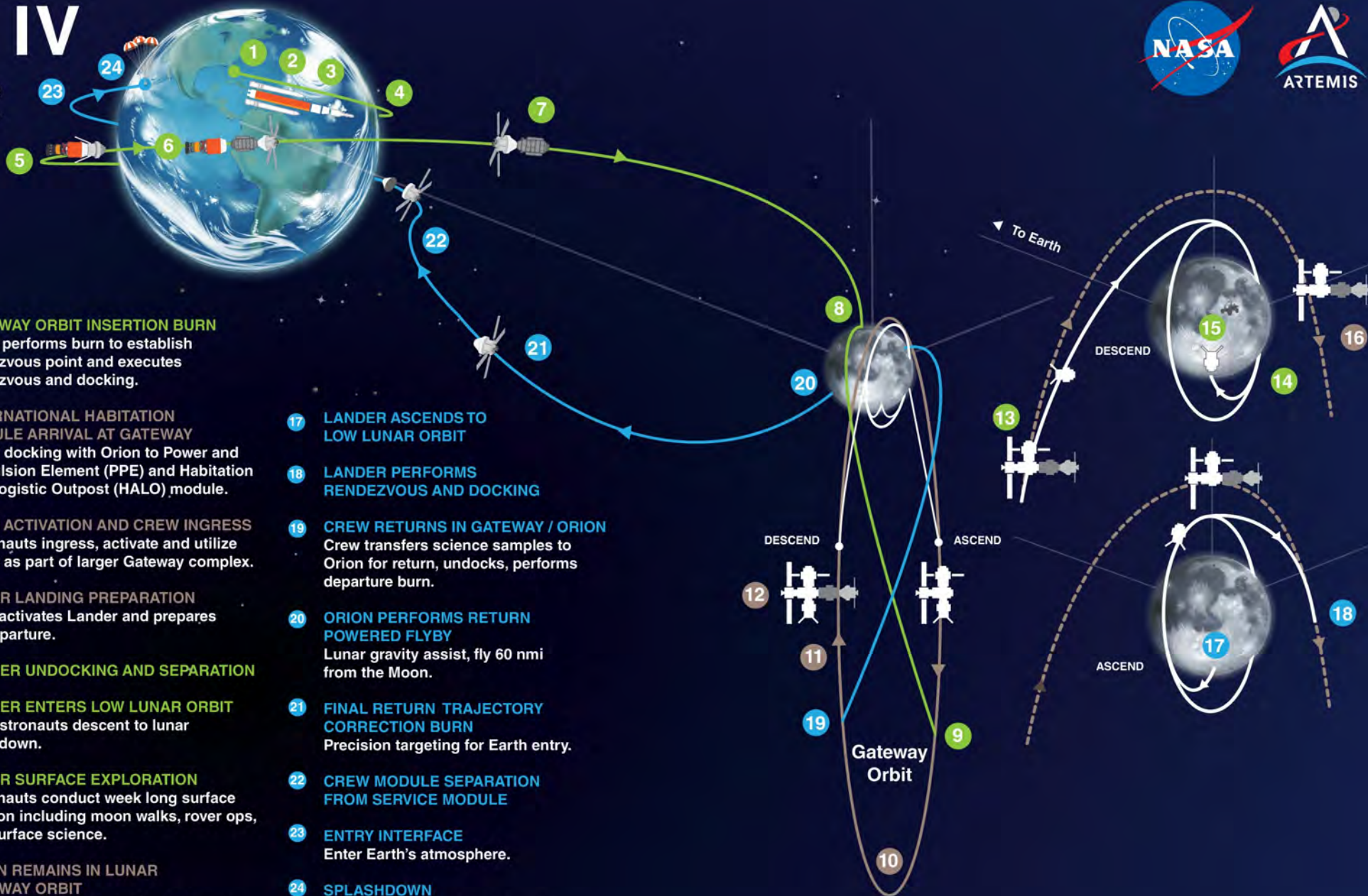
## 22 CREW MODULE SEPARATION FROM SERVICE MODULE

## 23 ENTRY INTERFACE

Enter Earth's atmosphere.

## 24 SPLASHDOWN

Astronaut crew, science sample and capsule recovery by ship.





# Artemis IV Mission Status



## Orion

- Crew Module is at KSC, installation of secondary structures is underway.
- Service Module integration progressing in Bremen, Germany.

## SLS

- Artemis IV demonstrates for the nation an enhanced Block 1B capability with 105t capacity to low-Earth orbit (LEO) and 38t to trans-lunar injection (TLI) using an Exploration Upper Stage (EUS) with four RL-10 engines, a Universal Stage Adaptor (USA), Payload Adaptor (PLA), and flight software.
- Production on the Engine Section, Intertank, Forward Skirt, LOX Tank, and LH2 Tank for the Core Stage in various stages of production. Final processing of the Core Stage RS-25 Engines is in-work at SSC and scheduled to be completed in early 2024.
- Booster motor segments are in production and scheduled to be complete in 2024.
- Production has begun on EUS, USA, and PLA articles for structural test, qualification and flight.

## EGS

- Mobile Launcher 2 (ML-2) construction and steel erection is progressing.

## Gateway

- PPE central cylinder assembly completed; Hardware integrity testing underway.
- Final weld of HALO Primary structure completed. Non-destructive inspections completed in October 2023.
- Hardware acceptance of the Gateway Inter-Element Adaptor completed.

## HLS

- Four Person Environmental Control Life Support System (ECLSS) demonstration review completed.
- Powered Utilization Payload Interface review completed.
- Standards adjudication is complete.

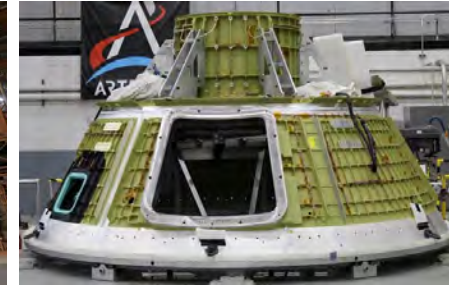


Image: SpaceX



# ARTEMIS

Artemis V Mission Status



# ARTEMIS V

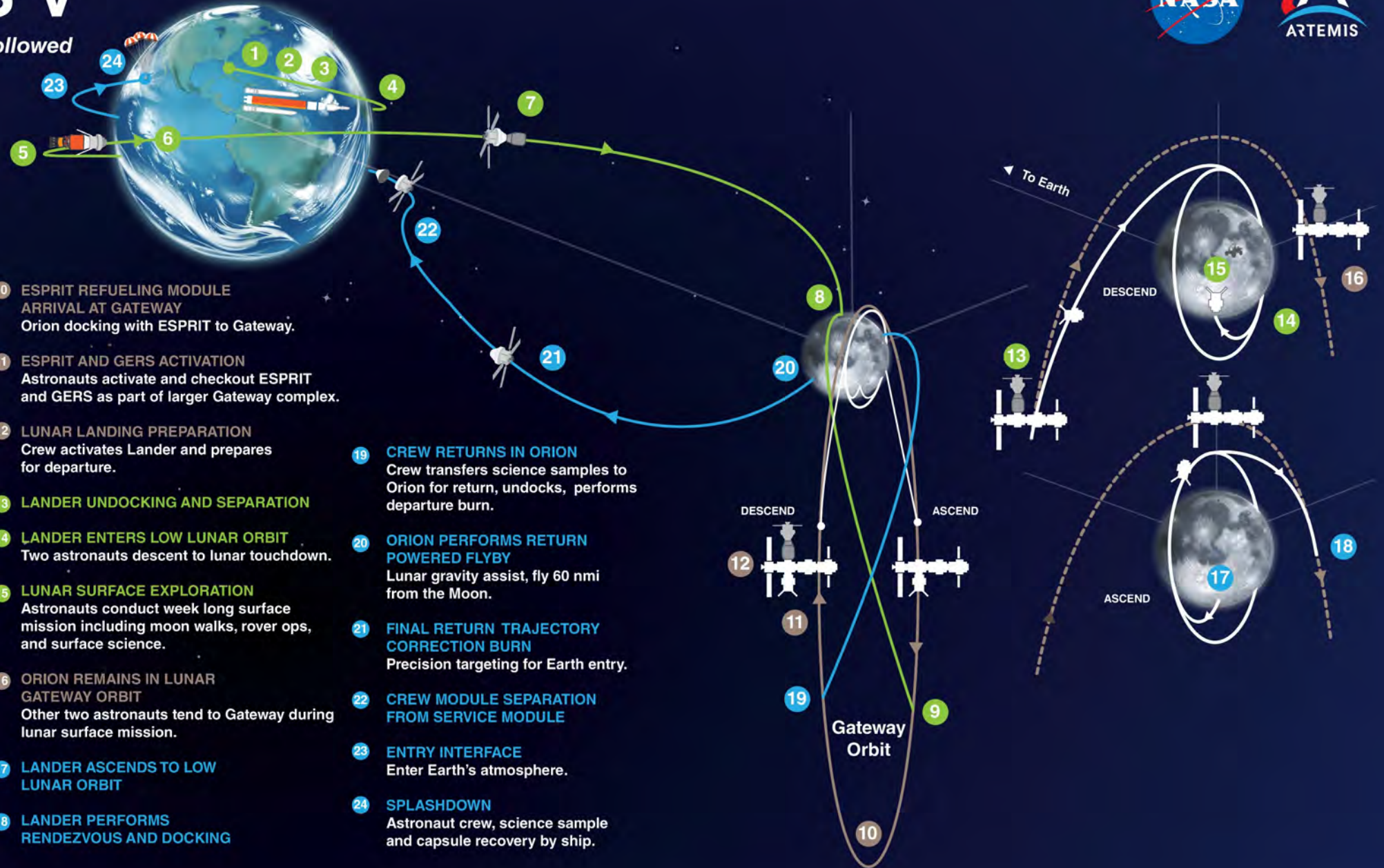
*ESPRIT delivery to Gateway followed by Crewed Lunar Landing*



- 1 LAUNCH**  
SLS with ESPRIT payload and crewed Orion lift-off from Kennedy Space Center.
- 2 JETTISON ROCKET BOOSTERS, FAIRINGS, AND LAUNCH ABORT SYSTEM**
- 3 CORE STAGE MAIN ENGINE CUT OFF**  
With separation.
- 4 ENTER EARTH ORBIT**  
Exploration Upper Stage performs circularization of Low Earth Orbit. Systems check and solar panel adjustments.
- 5 TRANS LUNAR INJECTION BURN**  
Exploration Upper Stage commits Astronauts in Orion and ESPRIT to lunar trajectory.
- 6 ORION TUGS ESPRIT TO MOON**  
Orion separation from USA, docking with ESPRIT and extraction from USA followed by Orion tug of ESPRIT to Gateway orbit and EUS disposal.
- 7 ORION OUTBOUND TRANSIT TO MOON**  
Perform periodic outbound trajectory correction maneuvers.
- 8 ORION OUTBOUND POWERED FLYBY**  
Lunar gravity assist, fly 60 nmi from the Moon.
- 9 GATEWAY ORBIT INSERTION BURN**  
Orion performs burn to establish rendezvous point and executes rendezvous.

- 10 ESPRIT REFUELING MODULE ARRIVAL AT GATEWAY**  
Orion docking with ESPRIT to Gateway.
- 11 ESPRIT AND GERS ACTIVATION**  
Astronauts activate and checkout ESPRIT and GERS as part of larger Gateway complex.
- 12 LUNAR LANDING PREPARATION**  
Crew activates Lander and prepares for departure.
- 13 LANDER UNDOCKING AND SEPARATION**
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Two astronauts descent to lunar touchdown.
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Enter Earth's atmosphere.
- 24 SPLASHDOWN**  
Astronaut crew, science sample and capsule recovery by ship.





A large, detailed image of the planet Mars, showing its reddish-brown surface with numerous craters and dark spots, set against a black background.

# Mars Campaign Office: Mars Risk Reduction Through Artemis



# Mars Campaign Office



The Mars Campaign Office (MCO) is responsible for maturing and demonstrating exploration capabilities necessary to enable human missions to Mars.

## Recent accomplishments include:

- **Brine Processor Assembly (BPA)** was built to increase water system recovery from 92% to 98% by processing previously discarded urine brine. BPA was successful in exceeding the goal in an extended ISS demonstration.
- **Toilet Acoustic Cover (TAC)** for Universal Waste Management System (UWMS) in Artemis II has been delivered for installation in the Artemis II vehicle at KSC.
- The upgraded **Purge Pump and Separator Assembly (PPSA)** was installed in the ISS Urine Processor Assembly and operated successfully but a recent anomaly is requiring additional investigation.
- **CapiSorb Visible System (CapiSorb)** ISS Flight Experiment was successfully completed. All objectives were met to inform feasibility of advanced Liquid Amines CO2 removal.
- On Oct 2<sup>nd</sup>, **Crew Health And Performance Analog (CHAPEA)** reached day 100 of their 378-day mission to assess crew health and performance during a typical Mars analog mission. Mission 1 started on June 25, 2023, is scheduled to complete on July 6, 2024, and has been fully successful to this point
- **Saffire VI** flammability experiment is waiting to be conducted in mid-December after undock of NG-19 from ISS. This completes the set of six Saffire experiments studying flammability in zero-G since Saffire I in 2016.

## Ongoing topic areas include:

- Environmental Control and Life Support (ECLSS) evolution
- Logistics Reduction
- Spacecraft Fire Systems
- Food Systems
- Exploration Medical Systems
- Autonomous Systems and Operations (ASO)
- Spacesuit Physiology
- Crew Health Countermeasures
- NASA Platform for Autonomous Systems (NPAS)
- Advanced Modular Power Systems (AMPS)

