

May 15, 2023

**NASA Advisory Council**

# ARTEMIS

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

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Moon to Mars Program Office

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# Outline

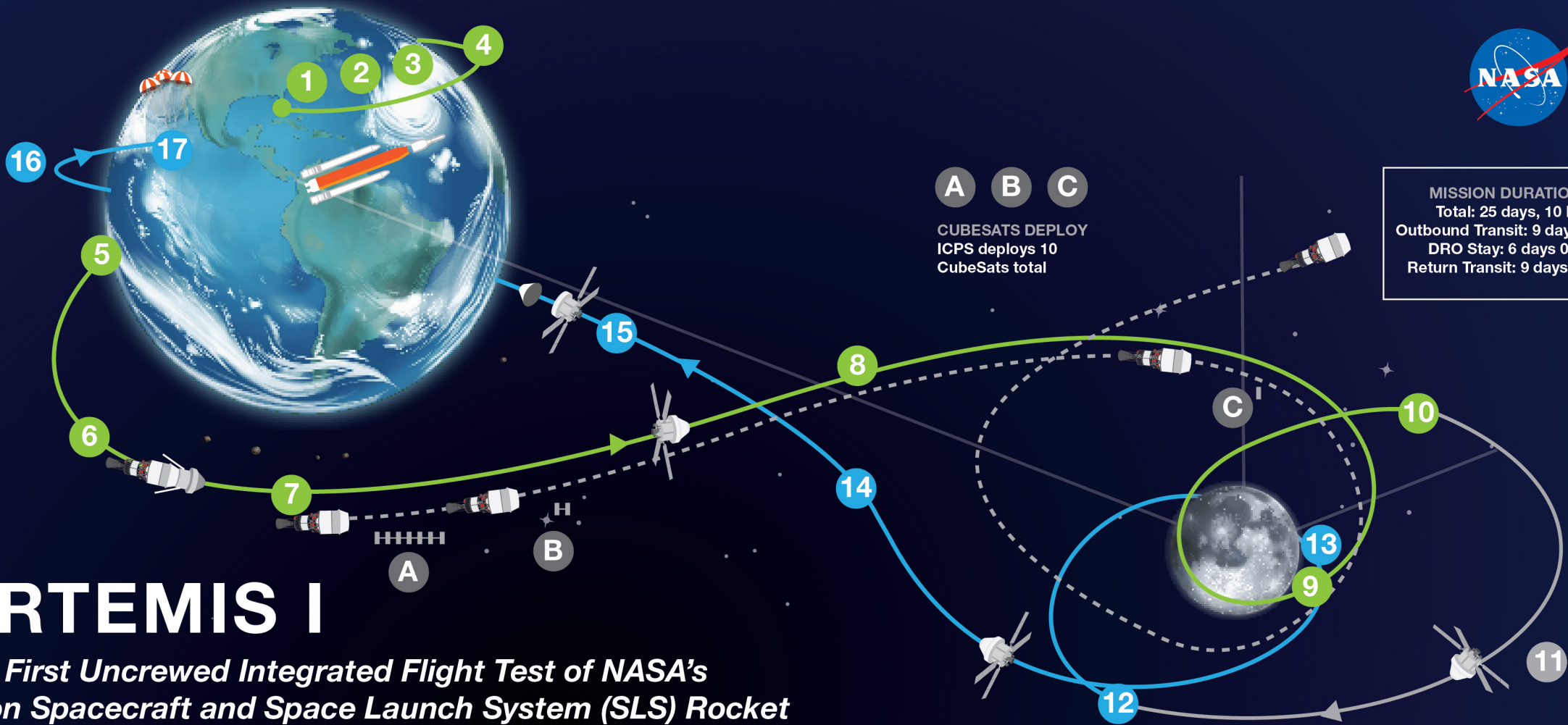
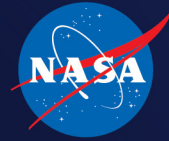


- Artemis I Accomplishments and Lessons Learned Status
- Artemis II Mission Status
- Artemis III Mission Status
- Artemis IV Mission Status
- Artemis V Mission Status
- Mars Campaign Office – Mars Risk Reduction Through Artemis



# ARTEMIS

Artemis I Accomplishments and  
Lessons Learned Status



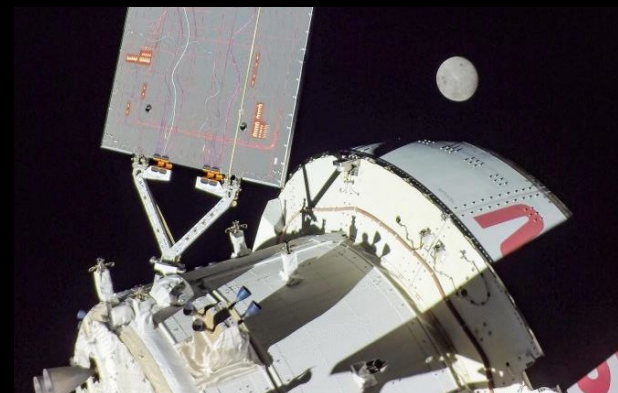
**A B C**  
 CUBESATS DEPLOY  
 ICPS deploys 10  
 CubeSats total

**MISSION DURATIONS:**  
 Total: 25 days, 10 hrs  
 Outbound Transit: 9 days 13 hrs  
 DRO Stay: 6 days 0 hrs  
 Return Transit: 9 days 19 hrs

# ARTEMIS I

*The First Uncrewed Integrated Flight Test of NASA's Orion Spacecraft and Space Launch System (SLS) Rocket*

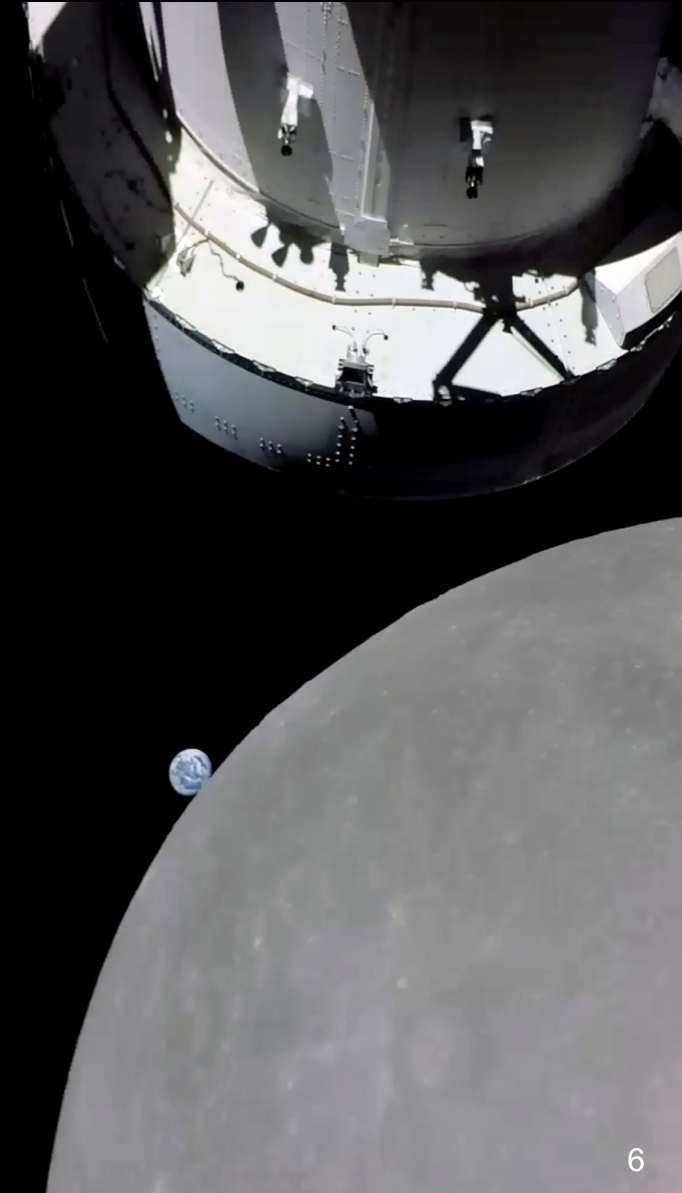
- 1 LAUNCH (11/16/22)**  
SLS and Orion lift off from pad 39B at Kennedy Space Center.
- 2 JETTISON ROCKET BOOSTERS, FAIRINGS, AND LAUNCH ABORT SYSTEM**
- 3 CORE STAGE MAIN ENGINE CUT OFF**  
with separation.
- 4 PERIGEE RAISE MANEUVER**
- 5 EARTH ORBIT**  
Systems check with solar panel adjustments.
- 6 TRANS LUNAR INJECTION BURN (TLI)**  
Maneuver lasts for approximately 20 minutes.
- 7 INTERIM CRYOGENIC PROPULSION STAGE (ICPS) SEPARATION AND DISPOSAL**  
ICPS commits Orion to Moon at TLI.
- 8 OUTBOUND TRAJECTORY CORRECTION BURNS**  
As necessary adjust trajectory for lunar flyby to Distant Retrograde Orbit (DRO).
- 9 OUTBOUND POWERED FLYBY**  
105.5 miles from the Moon; targets DRO insertion.
- 10 LUNAR ORBIT INSERTION**  
Enter DRO.
- 11 DRO**  
Perform one-half of a revolution (6-day duration) in the orbit 43,730 miles from the surface of the Moon.
- 12 DRO DEPARTURE**  
Leave DRO and start return to Earth.
- 13 RETURN POWERED FLYBY (RPF)**  
RPF burn prep and return coast to Earth initiated. Closest approach in middle of burn, 81 miles.
- 14 RETURN TRANSIT**  
Return trajectory correction burns as necessary to aim for Earth's atmosphere.
- 15 CREW MODULE SEPARATION FROM SERVICE MODULE**
- 16 ENTRY INTERFACE**  
Enter Earth's atmosphere.
- 17 SPLASHDOWN (12/11/22)**  
Pacific Ocean landing within view of the U.S. Navy recovery ship.



# Artemis I Accomplishments



- ✓ Demonstrated Orion's heat shield can withstand the high speed and heat conditions upon Earth return
- ✓ Demonstrated nominal operations and facilities during all mission phases
- ✓ Retrieved Orion after splashdown, with all procedures as expected
- ✓ Performed modal survey
- ✓ Certified optical navigation camera
- ✓ Characterized solar array wing camera Wi-Fi
- ✓ Performed crew module/service module surveys
- ✓ Demonstrated large file delivery protocol uplink
- ✓ Performed star tracker thermal assessment
- ✓ Examined radiator loop flow control
- ✓ Characterized solar array wing plume
- ✓ Characterized propellant slosh characteristics in space
- ✓ Search Acquire and Track (SAT) mode
- ✓ Gauged entry aerothermal performance
- ✓ Integrated Search and Rescue Satellite Aided Tracking, or SARSAT, functionality

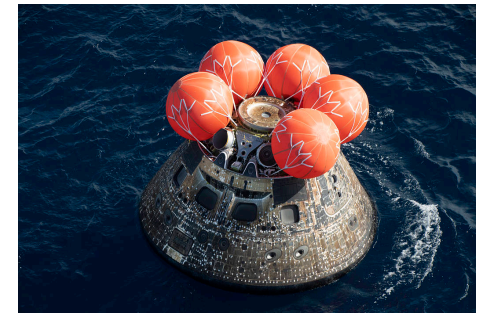
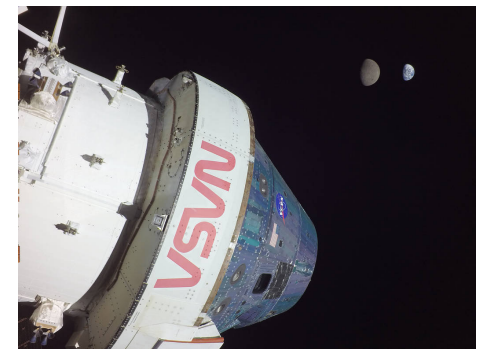
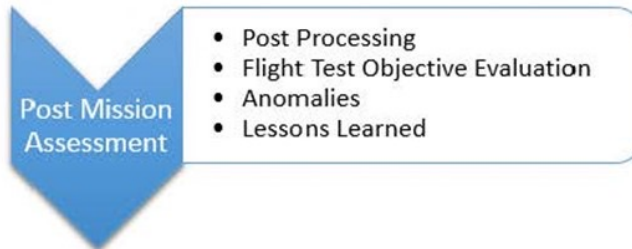


# Artemis I Lessons Learned Status



## Post flight assessment process:

- Postflight reconstruction
- Evaluation of mission and flight test objectives
- Evaluation and disposition of anomalies
- Collection of lessons learned



## The Post Flight Assessment Review (PFAR) is conducted after each mission in accordance with NPR 7123.1, NASA Systems Engineering Process and Requirements

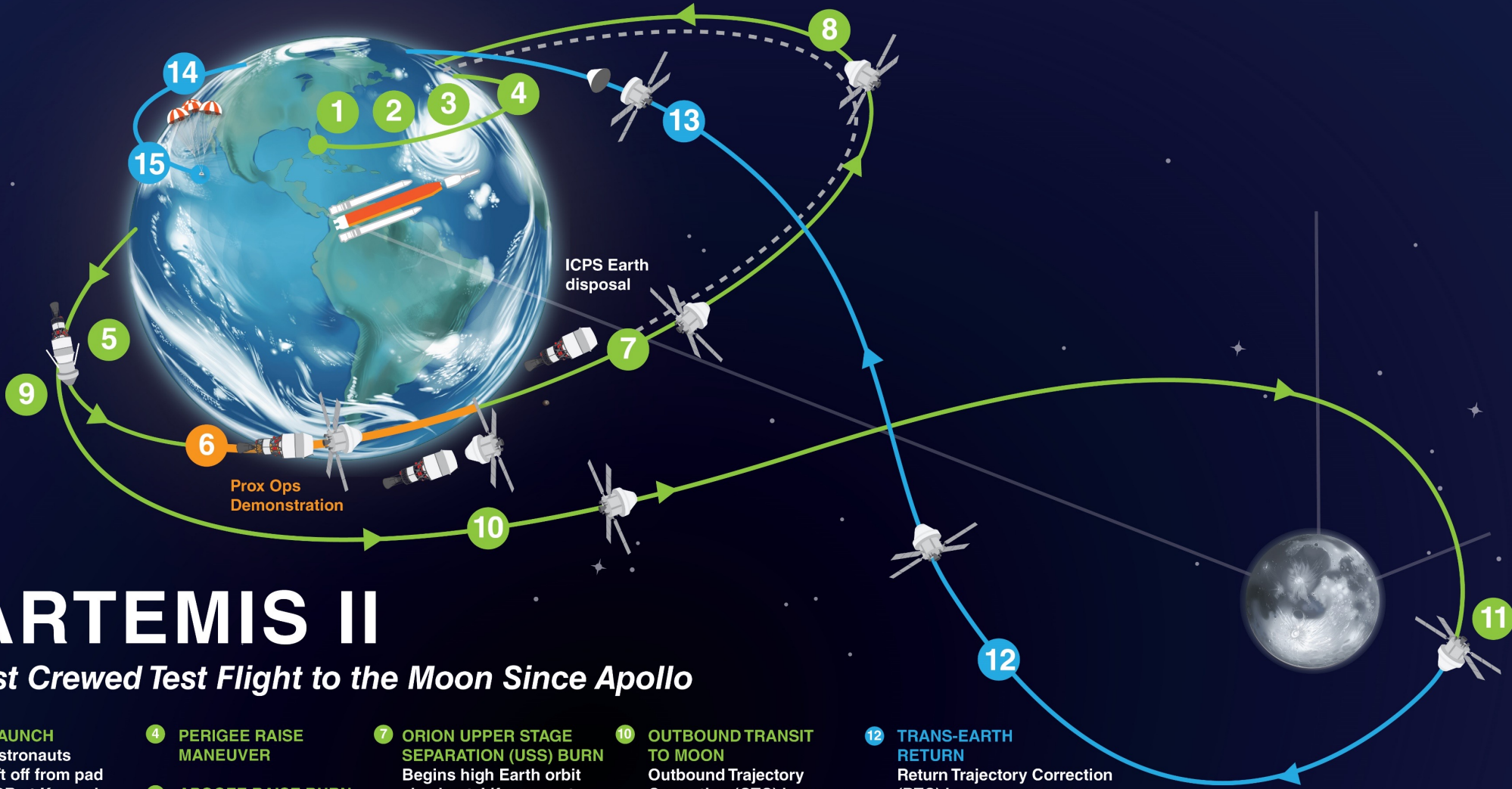
- This review is intended to assess the system performance and the success of mission objectives
- In addition, all flight and ground system anomalies that occurred during the mission are reviewed, and actions necessary to mitigate or resolve the anomalies for future flights are assigned
- Artemis I PFAR schedule:  
EGS: April 18 (complete); Orion: June 7; SLS: June 12; ESI: June 14; ESD: June 23



# 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**
- 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	9
1	10
2	11
3	12
4	13
5	14
6	15
7	16
8	17

# MAJOR MILESTONES FOR ARTEMIS II



PARACHUTES QUALIFIED FOR FLIGHT



\*CREW EGRESS TRAINING AT NBL



ORION PRESSURE VESSEL ELEMENTS MACHINED



\*HAND CONTROLLER EVAL



\*DOCKING HATCH EVAL



ORION WATER IMPACT TESTING



\*CREW EMERGENCY EGRESS TESTS



\*CREW AT SEA TEST



\*CREW MODULE UPRIGHT SYSTEM TEST



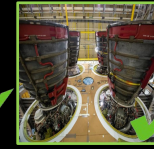
ORION ENVIRONMENTAL TESTS



HEAT SHIELD BLOCK INSTALL COMPLETE



SLS BOOSTER MOTOR SEGMENTS CAST



RS 25 ENGINES PROCESSED



SLS CORE STAGE PROOFING AND WELDING



\*HUMAN IN THE LOOP TESTS



\*DIVER RECOVERY TRAINING



ORION MISSION CONTROL SIMULATIONS



\*VACUUM PRESSURE CREW TEST



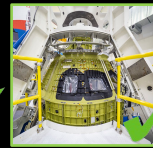
PRESSURE VESSEL COMPLETE



PRESSURE VESSEL ARRIVES AT KSC



\*DISPLAY AND CONTROL EVAL



ASSEMBLY, INTEGRATION, AND TESTING AT KSC



JETTISON MOTOR QUALIFIED



ATTITUDE CONTROL MOTOR QUALIFIED



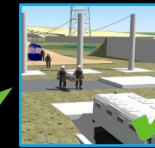
SLS RL10 ENGINE COMPLETION



CREW MODULE TRAINING ARTICLE TRANSPORTED TO LETF



\*EES MOCKUP EVALUATION



\*PAD EMERGENCY EGRESS SYSTEM 60% DESIGN REVIEW



\*EMERGENCY EGRESS SYSTEM BASKET PROTOTYPE



LH2 SPHERE



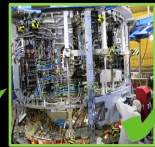
\*MOBILE LAUNCHER 1 60% DESIGN REVIEW



ENVIRONMENTAL CONTROL SYSTEM CHILLERS INSTALLED



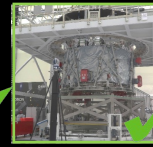
ENVIRONMENTAL CONTROL SYSTEM INFRASTRUCTURE INSTALLED



EUROPEAN SERVICE MODULE ASSEMBLY AT AIRBUS



EUROPEAN SERVICE MODULE SHIPS TO KSC



CREW MODULE ADAPTER/EUROPEAN SERVICE MODULE MATE



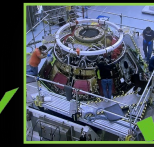
CORE STAGE 2 FORWARD JOIN



CORE STAGE 2 4/5ths JOIN



CORE STAGE 2 ENGINE SECTION BREAKOVER COMPLETE



ARTEMIS I ORION N/C AVIONICS INSTALLATION IN ARTEMIS II CREW MODULE



SLS LAUNCH VEHICLE STAGE ADAPTER COMPLETION



HEAT SHIELD INSTALL ON CREW MODULE



SLS INTERIM CRYOGENIC PROPULSION STAGE (ICPS) READY FOR TRANSFER TO EGS



CREW MODULE COMPLETE



CREW AND SERVICE MODULE MATE



MOBILE LAUNCHER 1 ROLL TO PAD FOR MEVV



CORE STAGE 2 READY FOR SHIPMENT TO KSC



BOOSTERS ARRIVE AT KSC



EGS BOOSTER OFFLINE PROCESSING START



\*VAB ECS UPGRADES COMPLETE



\*PAD UPGRADES COMPLETE



EGS OPERATIONAL READINESS CHECKPOINT



\*MOBILE LAUNCHER 1 MULTI ELEMENT V&V AT PAD COMPLETE



\*MOBILE LAUNCHER 1 MULTI ELEMENT V&V AT VAB COMPLETE



ORION HANDOVER TO EGS



EGS ORION OFFLINE PROCESSING START



BOOSTER STACKING COMPLETE



SLS CORE STAGE, ICPS, & ADAPTERS INTEGRATION AT KSC



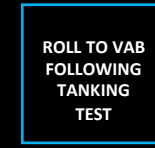
ORION MASS SIMULATOR MATE



ROLL TO PAD FOR TANKING TEST



ARTEMIS II TANKING TEST



ROLL TO VAB FOLLOWING TANKING TEST



ORION TO VAB



ORION INTEGRATION TO SLS



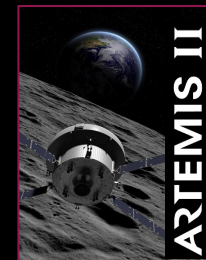
CONDUCT FINAL INTEGRATED TESTING



ROLL TO PAD FOR LAUNCH



ARTEMIS II LAUNCH



ARTEMIS II

Unique aspect of Artemis II (\* unique for crew config.)

# Artemis II Mission Status



## Mission

- Artemis II crew (Victor Glover, Christina Hammock Koch, Jeremy Hansen, and Reid Wiseman) announced on April 5, 2023
- Artemis II Mission Integration Review (MIR) planned June 6 to 8, 2023

## Orion

- Crew module has completed thermal cycle testing and is proceeding with final hardware installations
- Service module continues with integrated testing

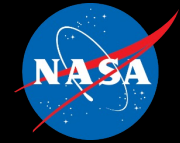
## SLS

- All 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 progress at Michoud Assembly Facility (MAF) is on plan to complete by early fall 2023; All four core stage engines were delivered to MAF, and engine installation is to complete by June 2023
- Interim cryogenic propulsion stage (ICPS) manufacturing is complete and is at United Launch Alliance (ULA) facilities at the Cape for testing and final preparations. Launch vehicle stage adaptor (LVSA) is complete and ready for delivery
- All solid rocket motor segments for Artemis II have been cast and are in storage in Utah

## EGS

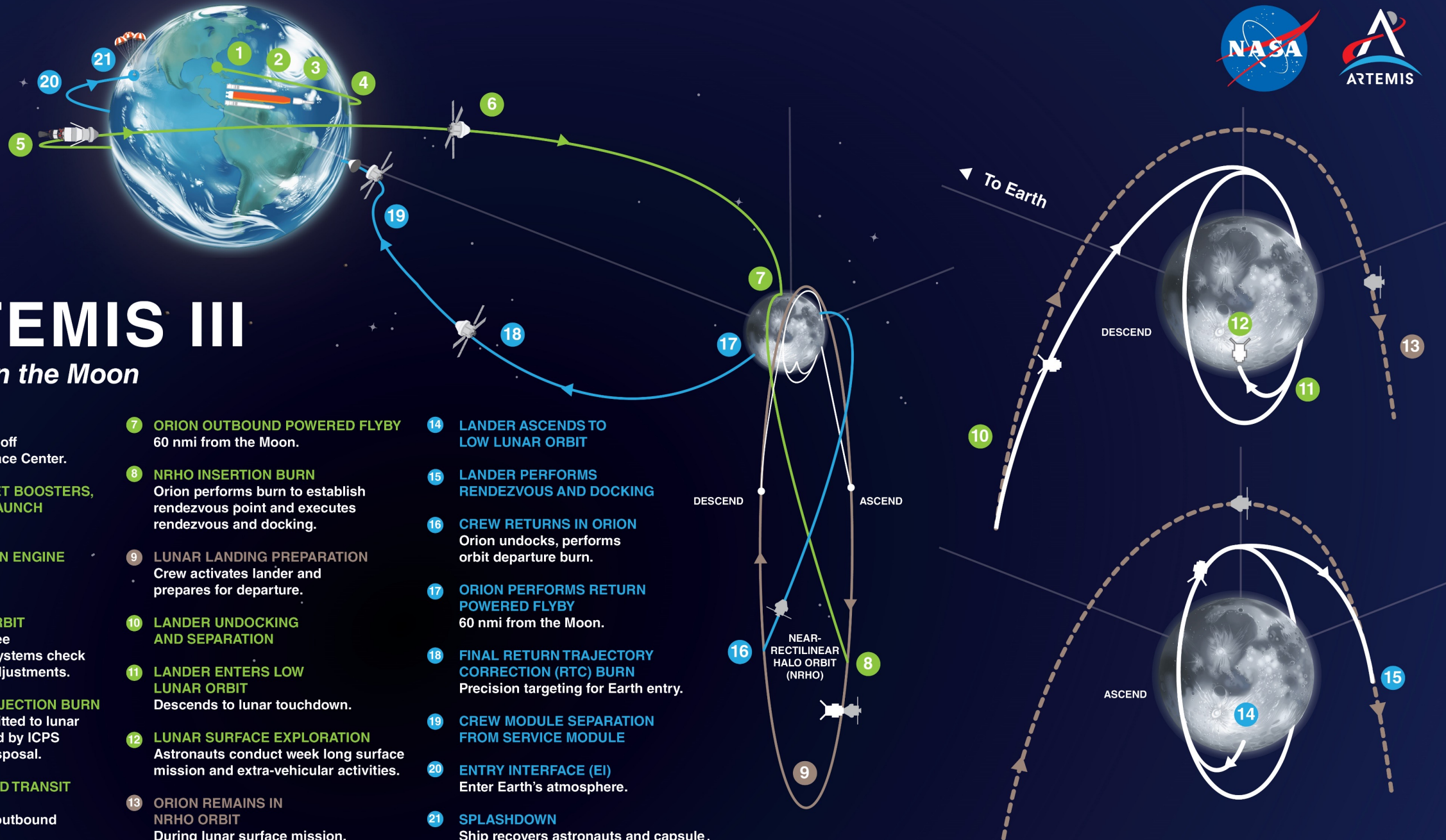
- Mobile launcher 1 (ML-1) refurbishment is on track to support Artemis II processing
- Artemis II modifications (crew access arm, emergency egress system, environmental control system in the Vertical Assembly Building and at the pad, and new 1.4-million-gallon liquid hydrogen sphere) are moving forward to support processing





# 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.

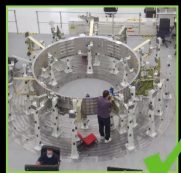
# Major Milestones for Artemis III



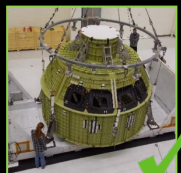
## Crewed Launch Milestones



ICPS 3 ENGINE DELIVERY TO ULA



CREW MODULE ADAPTER INNER WALL DELIVERED TO O&C



CREW MODULE PRESSURE VESSEL DELIVERED TO O&C



CREW MODULE PRESSURE VESSEL PROOF TEST COMPLETED



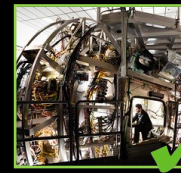
MOTOR SEGMENTS COMPLETE



SLS INTEGRATED CRYOGENIC PROPULSION SYSTEM PRODUCTION COMPLETE



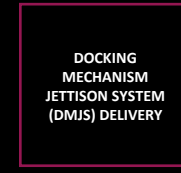
ENGINES READY FOR DELIVERY TO MAF



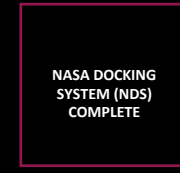
CONFIGURE ORION INTEGRATED TEST LAB FOR ARTEMIS III



ORION CREW MODULE ADAPTER COMPLETE



DOCKING MECHANISM JETTISON SYSTEM (DMJS) DELIVERY



NASA DOCKING SYSTEM (NDS) COMPLETE



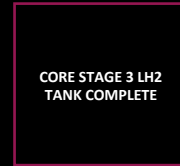
EUROPEAN SERVICE MODULE DELIVERY TO O&C



CORE STAGE 3 INTERTANK COMPLETE



CORE STAGE 3 FWD SKIRT COMPLETE



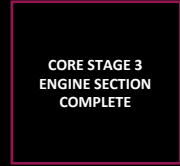
CORE STAGE 3 LH2 TANK COMPLETE



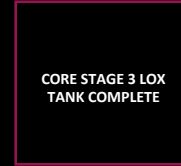
ORION STAGE ADAPTER COMPLETE



SLS LAUNCH VEHICLE STAGE ADAPTER COMPLETE



CORE STAGE 3 ENGINE SECTION COMPLETE



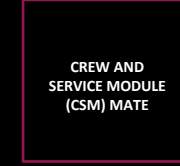
CORE STAGE 3 LOX TANK COMPLETE



ORION CREW MODULE READY FOR MATE



ORION SERVICE MODULE READY FOR MATE



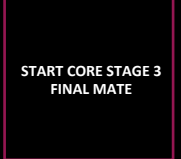
CREW AND SERVICE MODULE (CSM) MATE



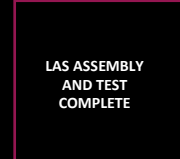
BOOSTER AFT SKIRTS COMPLETE



BOOSTER FORWARD ASSEMBLY COMPLETE



START CORE STAGE 3 FINAL MATE



LAS ASSEMBLY AND TEST COMPLETE



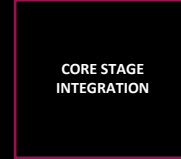
CORE STAGE 3 COMPLETE



START BOOSTER STACKING



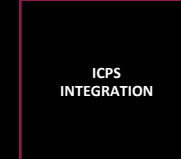
ORION CSM DELIVERY TO EGS



CORE STAGE INTEGRATION



LAUNCH VEHICLE STAGE ADAPTER INTEGRATION



ICPS INTEGRATION



ORION STAGE ADAPTER INTEGRATION



ORION MPPF PROCESSING COMPLETE



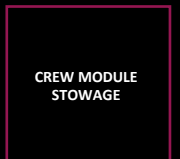
ORION TO VAB



ORION INTEGRATION TO SLS COMPLETE



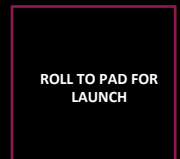
ORION SPECIFIC TESTING



CREW MODULE STOWAGE



FINAL CLOSEOUTS FOR LAUNCH & FSS

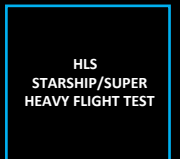


ROLL TO PAD FOR LAUNCH

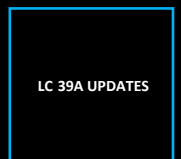


EGS READY FOR ARTEMIS III LAUNCH

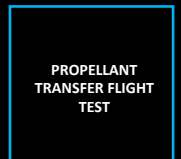
## HLS and EHP Milestones



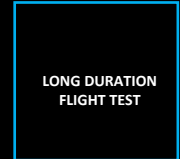
HLS STARSHIP/SUPER HEAVY FLIGHT TEST



LC 39A UPDATES



PROPELLANT TRANSFER FLIGHT TEST



LONG DURATION FLIGHT TEST



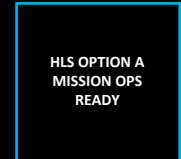
HLS UNCREWED LUNAR LANDING DEMO LAUNCH



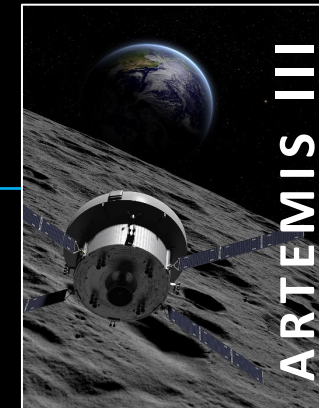
SCIENCE INSTRUMENT(S) DELIVERY FOR HLS INTEGRATION



EHP XEVA READY FOR INTEGRATION



HLS OPTION A MISSION OPS READY



ARTEMIS III

Rev E  
As of 4/27/2023

New milestones for Artemis III

# Artemis III Mission Status



## Mission, Science, and Utilization

- Geospatial data team completed narrow-angle camera mosaics of all 13 landing sites
- Lunar surface science workshop held in April to gather further data and points-of-interest within the designated 13 landing regions from the science community
- Science instrument and science team selection in progress

## Orion

- Artemis III build in progress; 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.
- Core stage scheduled to be complete in early 2025. All core stage engines are in storage at SSC. ICPS, LVSA, and Orion Stage Adaptor (OSA) scheduled to be complete by summer 2024
- All solid rocket motor segments for Artemis III have been cast and are in storage in Utah

## EGS

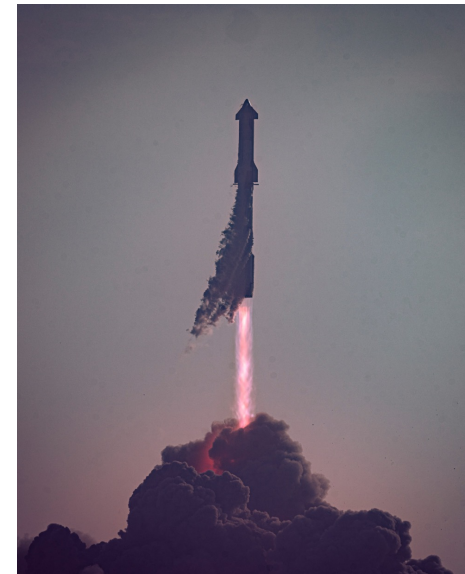
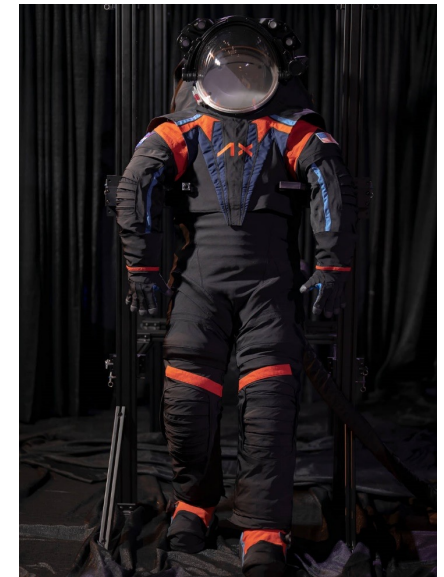
- No significant changes planned for Artemis III

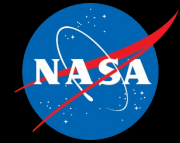
## HLS

- Conducted Program Alignment Review of integrated technical baseline for KDP-C
- Starship/Super Heavy wet dress rehearsals and static fires completed at Boca Chica, Texas
- Starship/Super Heavy Flight test on April 20. Achieved ~39 km apogee. Significant data collected. Investigation underway: SpaceX-led with FAA oversight and NASA observers.

## EHP

- Axiom development suit unveiled





# 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.

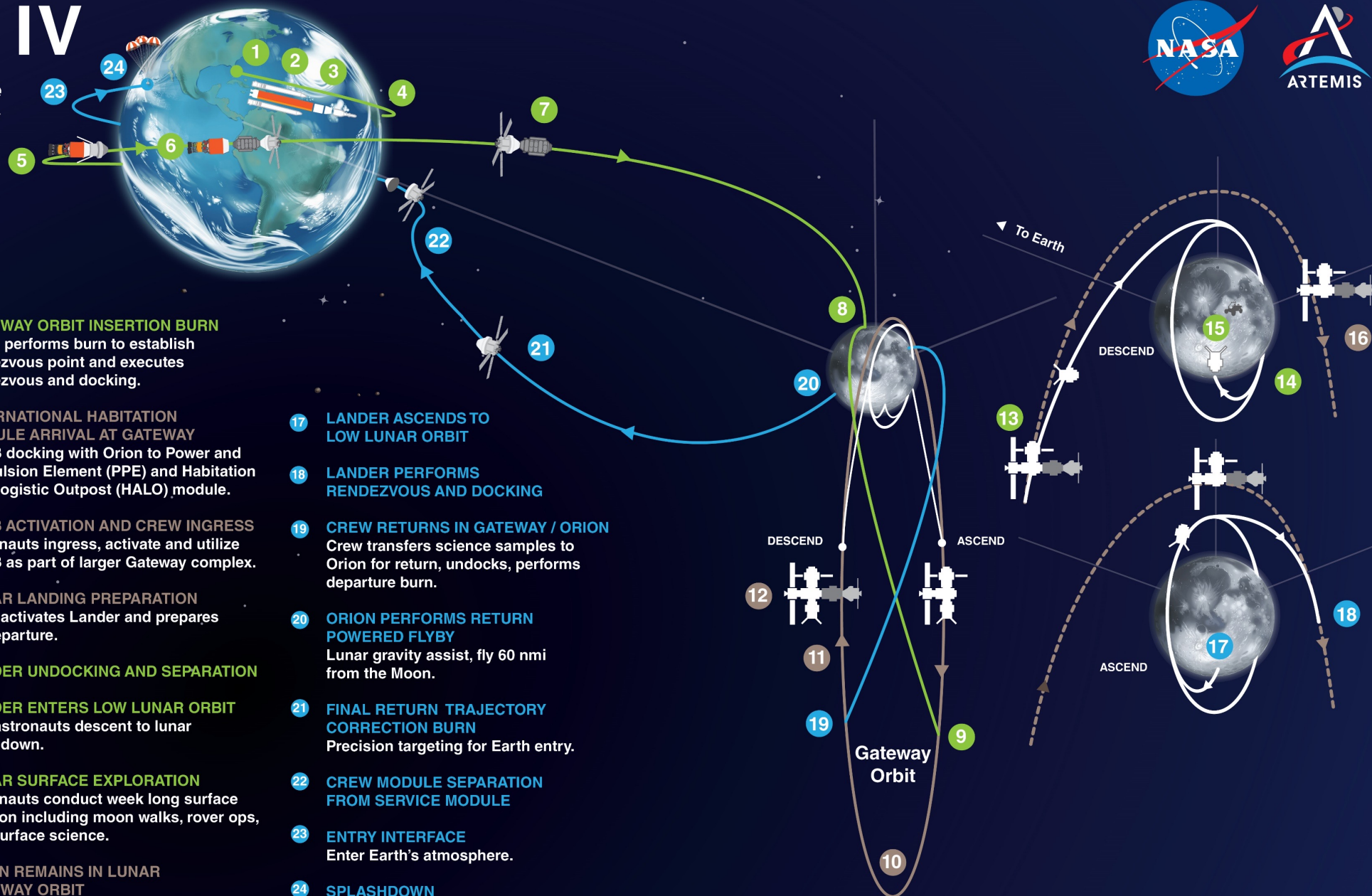
## 22 CREW MODULE SEPARATION FROM SERVICE MODULE

## 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 delivered to KSC and primary structure buildup is in work
- Service module integration progressing in Bremen, Germany

## SLS

- Artemis IV demonstrates for the nation an initial Block 1B capability with 105t capacity to low-Earth orbit (LEO) and 38t to trans-lunar injection (TLI) with a exploration upper stage (EUS) with four RL-10 engines, a universal stage adaptor (USA), payload adaptor (PLA), and flight software
- Weld Confidence Articles (WCAs) for EUS have started, with one completed in April 2023. Five WCAs remain
- Booster motor segments casing in work and scheduled to be complete in summer 2024
- USA and PLA scheduled for completion in 2025

## EGS

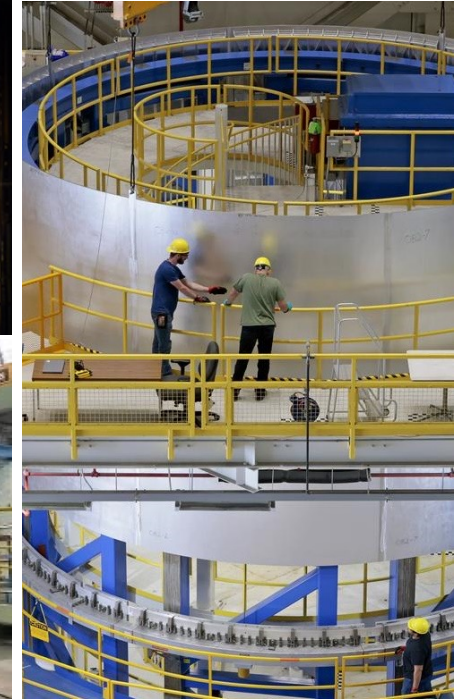
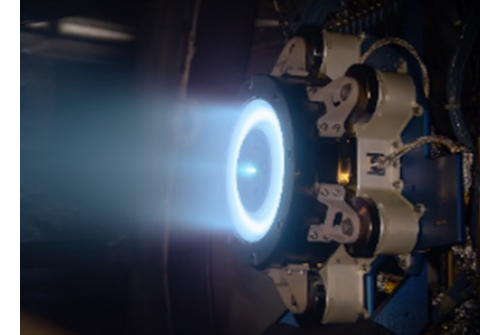
- Mobile Launcher 2 (ML-2) iCDR board held on March 9, 2023.
- Steel erection anticipated fall 2023

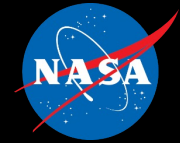
## Gateway

- Completed PDR-informed sync review technical closeout in December 2022. PDR programmatic closeout planned for May 2023
- HALO completed multiple subsystem CDR closeouts and phase 2 safety panel sessions. C2 weld repair complete and teams are assessing results. Two welds remain
- PPE completed implementation review in December 2022. PPE completed end-to-end tests for both 12kW (AEPS) and 6kW (Busek) electric propulsion strings
- IHAB primary structure began in first quarter 2023. HLCS CDR completed in April 2023. ECLSS PDR closeout planned for second quarter 2023.
- Integrated analysis cycle 9 (IAC9) ongoing, with analysis to include large lander

## HLS

- Awarded Option B contract mod to SpaceX (Art-IV lander) – November 2022
- Completed Preliminary Gateway Integration Checkpoint – January 2023
- Completed Standards Adjudication – March 2023





# ARTEMIS

Artemis V Mission Status

# ARTEMIS V

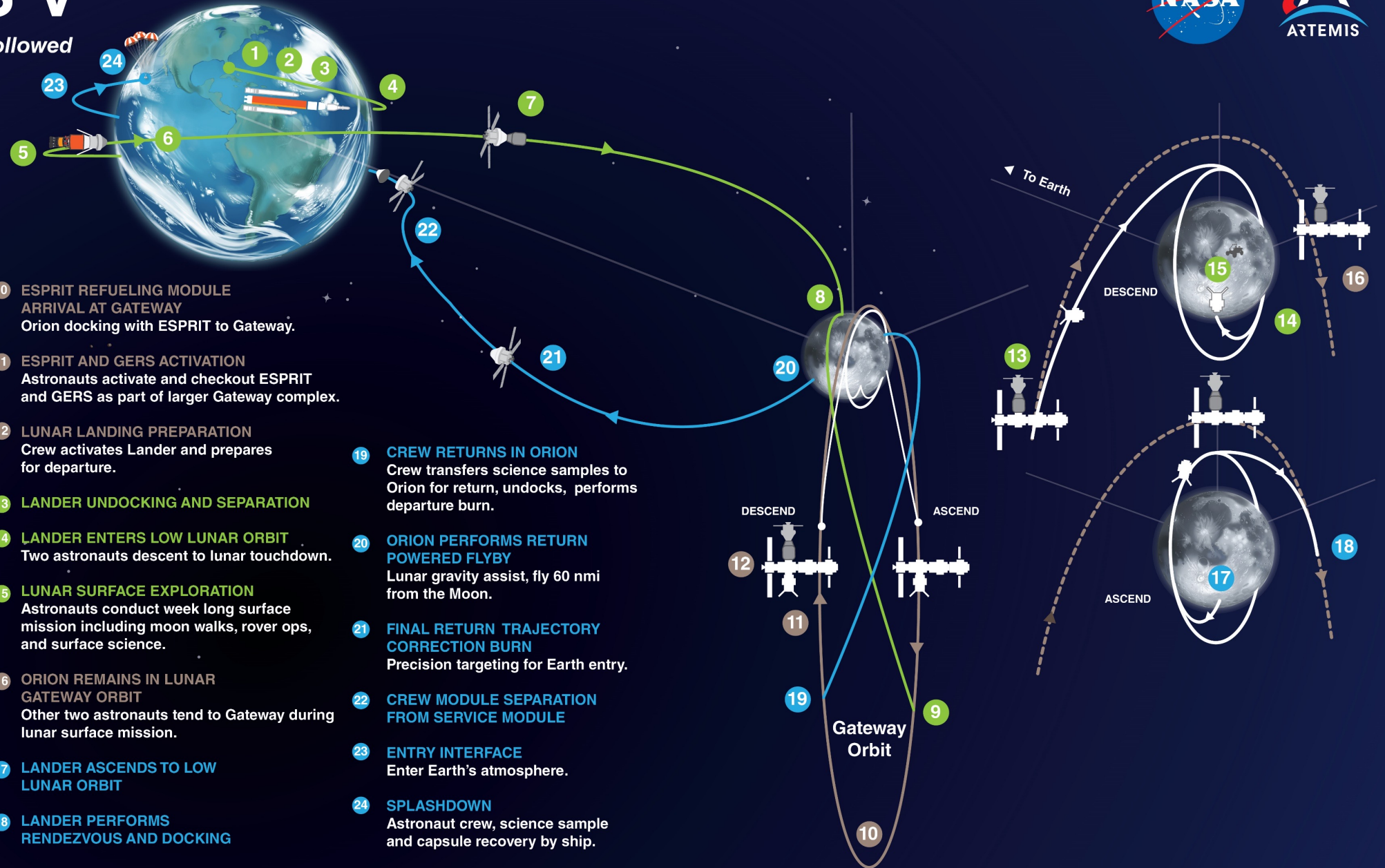
*ESPRIT delivery to Gateway followed by Crewed Lunar Landing*



- 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**
- 14 LANDER ENTERS LOW LUNAR ORBIT**  
Two astronauts descent to lunar touchdown.
- 15 LUNAR SURFACE EXPLORATION**  
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Other two astronauts tend to Gateway during lunar surface mission.
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- 19 CREW RETURNS IN ORION**  
Crew transfers science samples to Orion for return, undocks, performs departure burn.
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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.



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:

- CAPSTONE
- RadWorks
- Shadow Cam
- MOXIE

## Ongoing topic areas include:

- Environmental control and life support (ECLSS) evolution
- Logistics reduction
- Spacecraft fire systems
- Food systems
- Exploration medical systems
- Spacesuit physiology
- Crew health countermeasures
- Autonomous Systems and operations (AS)
- NASA Platform for Autonomous Systems (NPAS)
- Advanced Modular Power Systems (AMPS)

