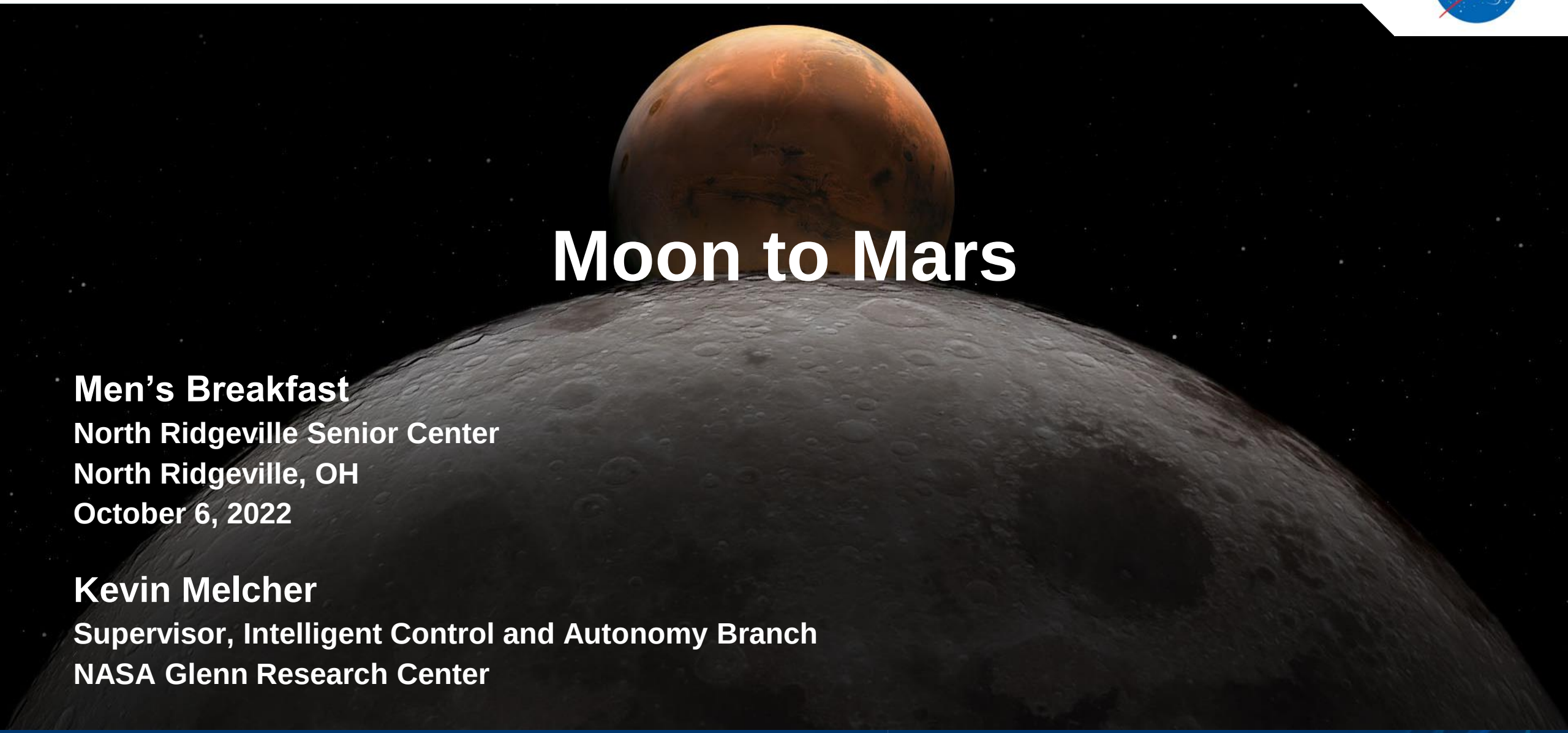


Moon to Mars

Men’s Breakfast

North Ridgeville Senior Center
North Ridgeville, OH
October 6, 2022

Kevin Melcher
Supervisor, Intelligent Control and Autonomy Branch
NASA Glenn Research Center

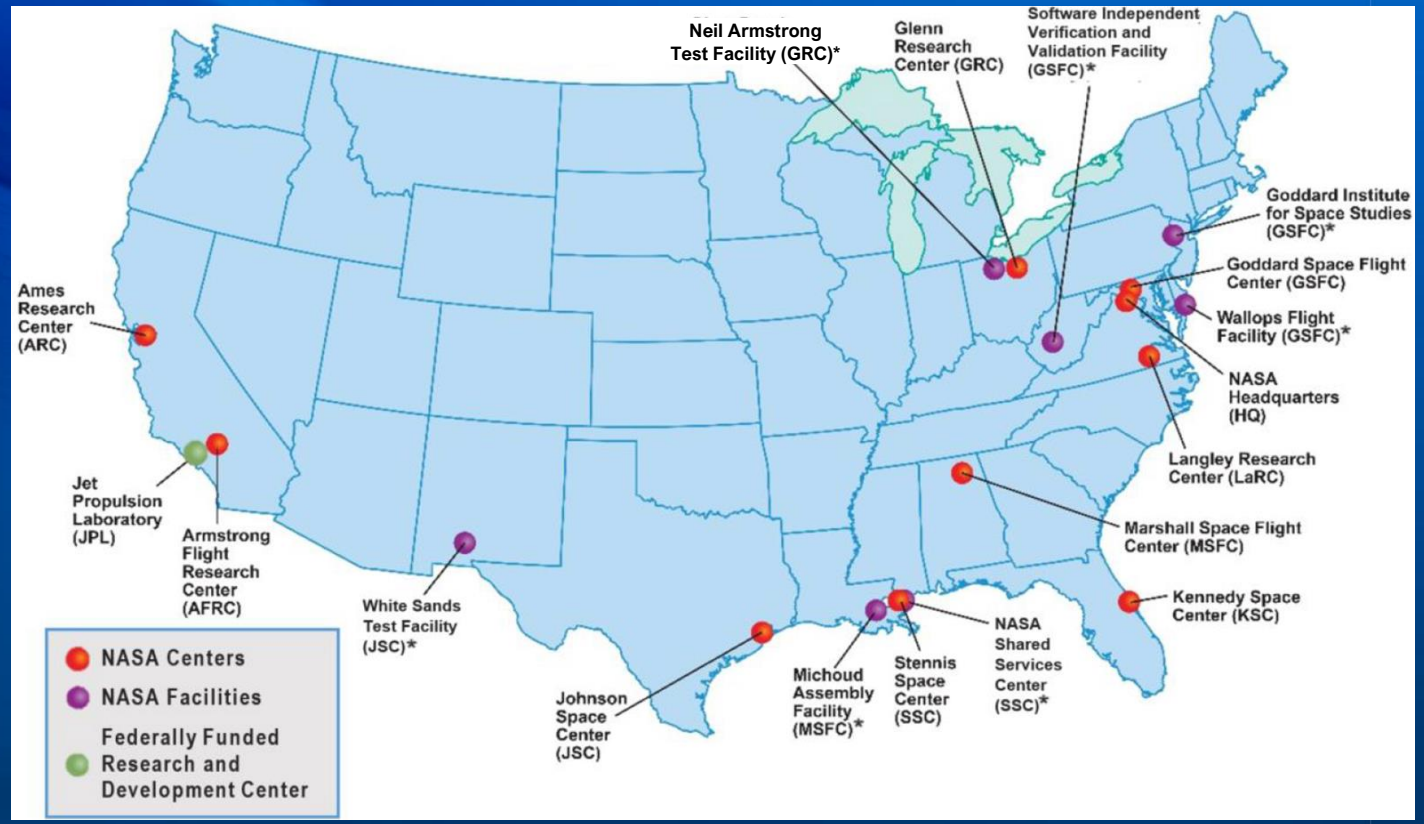
Agenda

- About the Speaker
- Overview of NASA Glenn
- Moon to Mars
  - Why go to the moon?
  - How are we going to the moon?
- Artemis Overview & Updates
- Questions

About the speaker …

- Professional
  - Co-operative Engineering Student, Wright Patterson AFB, 1980-1982
  - B.S., Applied Mechanics, Univ. of Cincinnati, 1983
  - Research Engineer, NASA Glenn, JUN1983-SEP2018
  - M.S., Mechanical Engineering, Cleveland State Univ., 1996
  - Supervisor, NASA Glenn, SEP2018-present
- Personal
  - Originally from Morrow County, OH
  - Resident of North Ridgeville since 1988
  - Three children attended and graduated from North Ridgeville schools
  - Son-in-law of Carol Curp
  - Anticipate playing cards at the Senior Center within a few years

NASA Facilities



- The National Aeronautics and Space Administration has centers and facilities spread across the U.S.
- Each Center/Facility has set of core competencies
- The John H. Glenn Research Center at Lewis Field and the Neil Armstrong Test Facility are located in northern Ohio

NASA Glenn Research Center

Lewis Field (Cleveland)

- 350 acres
- 1,500+ civil servants
- 1,700+ contractors

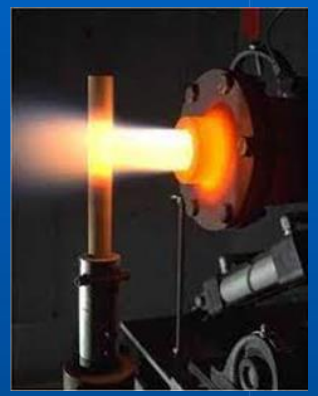
Armstrong Test Facility (Sandusky)

- 6,500 acres
- 21 civil servants
- 100+ contractors

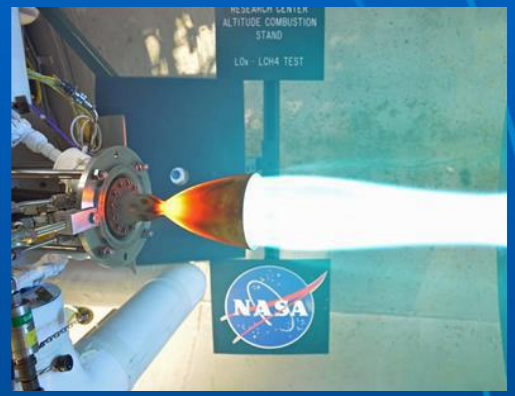
NASA Glenn Core Competencies

Aircraft Propulsion

Materials & Structures for Extreme Environments



Space Propulsion & Cryogenic Fluids



Power, Energy Storage & Conversion

Communications Technologies

Physical Sciences & Biomedical Technologies for Space Missions

Moon to Mars

- In September 2022, NASA published revised *Moon to Mars* goals and objectives

Why go to the Moon?

Moon to Mars

Why go to the moon?

- scientific discovery

Lunar/Planetary Science (LPS)
Goal: Address high priority planetary science questions that are best accomplished by on-site human explorers on and around the Moon and Mars, aided by surface and orbiting robotic systems.

Moon to Mars

Why go to the moon?

- scientific discovery

Human and Biological Science (HBS) Goal: Advance understanding of how biology responds to the environments of the Moon, Mars, and deep space to advance fundamental knowledge, support safe, productive human space missions and reduce risks for future exploration.

Moon to Mars

Why go to the moon?

- scientific discovery

Science-Enabling (SE) Goal: Develop integrated human and robotic methods and advanced techniques that enable high-priority scientific questions to be addressed around and on the Moon and Mars.

Moon to Mars

Why go to the moon?

- scientific discovery, economic benefits

Lunar Infrastructure (LI) Goal: Create an interoperable global lunar utilization infrastructure where U.S. industry and international partners can maintain continuous robotic and human presence on the lunar surface for a robust lunar economy without NASA as the sole user, while accomplishing science objectives and testing for Mars.

Moon to Mars

Why go to the moon?

- maintain American leadership in exploration
- build a global alliance and explore deep space for the benefit of all

Moon to Mars

Why go to the moon?

- inspiration for a new generation of explorers, the Artemis Generation

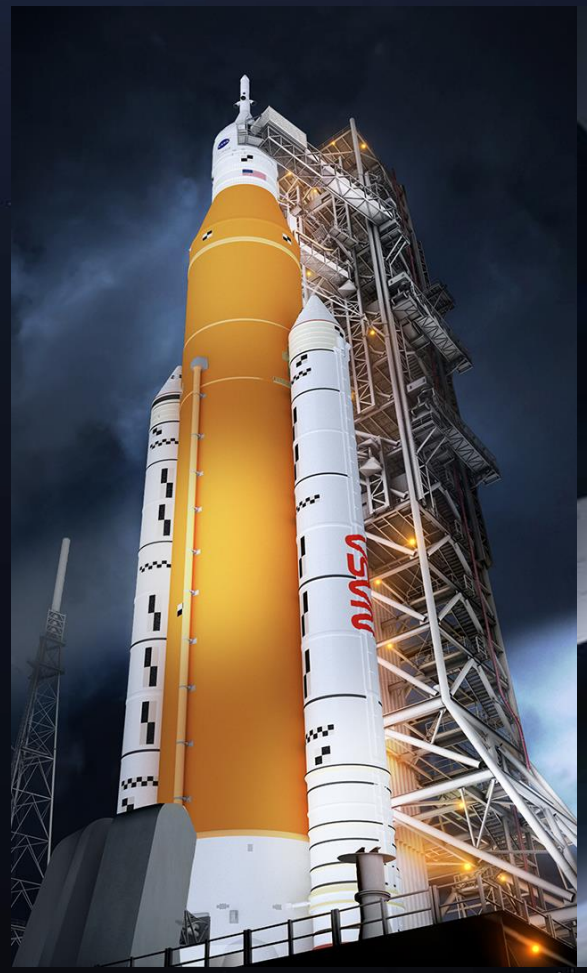
How are we going to the moon?

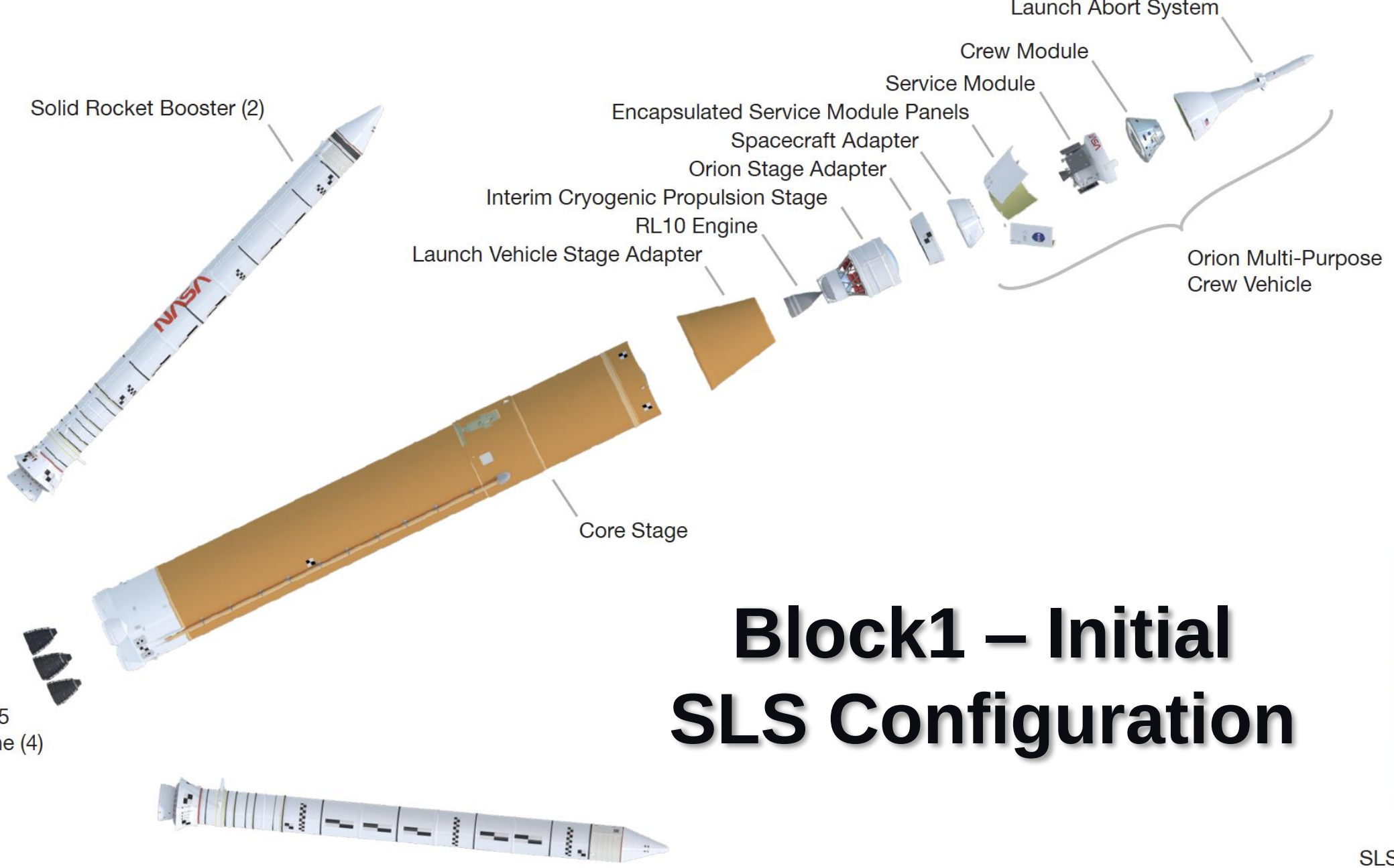
With Artemis missions, NASA will:

- land the first woman and first person of color on the Moon
- use innovative technologies to explore more of the lunar surface than ever before
- collaborate with commercial and international partners to establish the first long-term presence on the Moon
- use what we learn on and around the Moon to take the next giant leap: sending the first astronauts to Mars

How are we going to the moon?

- Space Launch System Rocket
- Orion Spacecraft





Block1 – Initial SLS Configuration

SLS Block 1 Crew

The Apollo Spacecraft 106/Command/Service Module pictured on Jan. 31, 1969. (Credit: NASA)

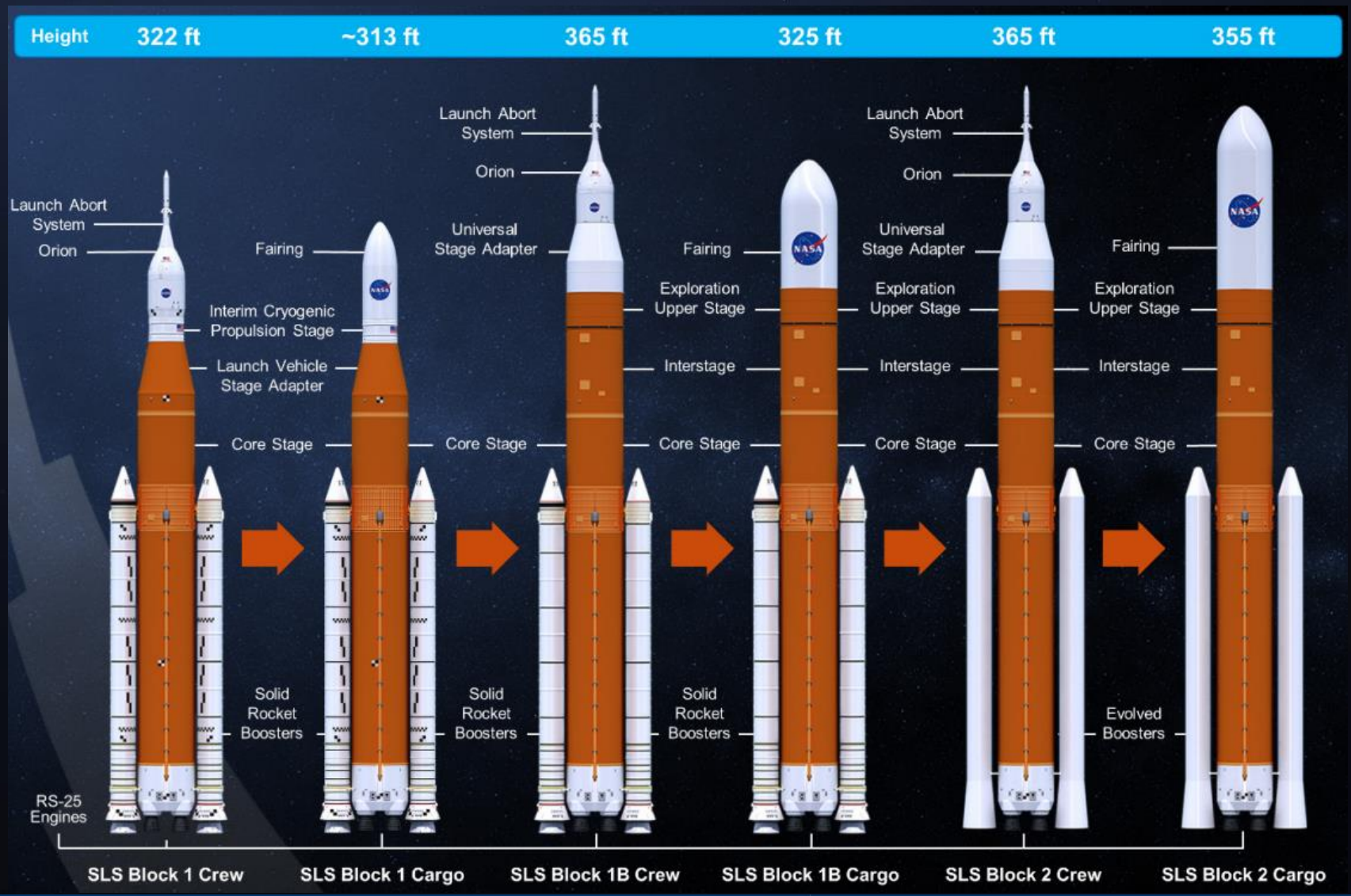
	Apollo	Orion
No. Crew	3	4
Ht. Crew Mod	10’ 7”	11’
Dia. Crew Mod	12’ 10”	16’ 6”
Habitable Space	210 ft^3	316 ft^3
Max Mission	14 days	21 days

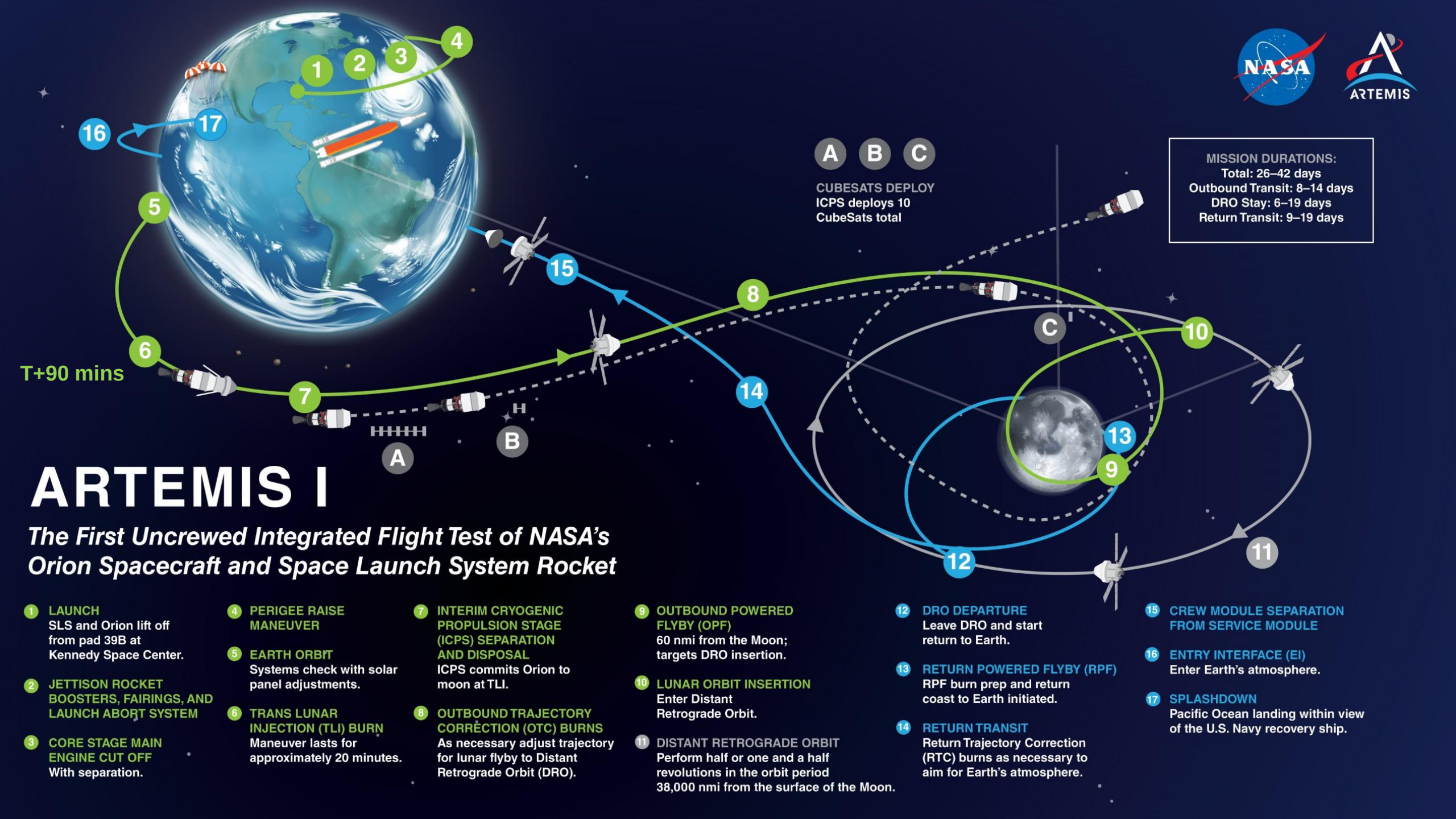
The Orion spacecraft pictured on Jan. 14, 2021. (Credit: NASA)

	Saturn V	SLS B1
Lift-off Weight (lbs)	6.5M	5.75M
Height (ft)	363	322
No. Prop. Stages	3	2
No. Boosters	0	2
Thrust/Booster (lbs)	n/a	3.38M
No. Engines	5	4
Thrust/Engine (lbs)	1.52M	0.512M
Total Thrust (lbs)	7.6M	8.8M
Lunar payload (lbs)	90K	59.5K

Space Launch System Block 1/ Source: https://www.nasa.gov/exploration/systems/sls/markings-on-sls-provide-a-different-view-of-the-artemis-i-launch.html

ARTEMIS


Height
322 ft
~313 ft
365 ft
325 ft
365 ft
355 ft
Launch Abort System
Orion
Fairing
Universal Stage Adapter
Exploration Upper Stage
Interim Cryogenic Propulsion Stage
Launch Vehicle Stage Adapter
Interstage
Core Stage
Solid Rocket Boosters
Evolved Boosters
RS-25 Engines
SLS Block 1 Crew
SLS Block 1 Cargo
SLS Block 1B Crew
SLS Block 1B Cargo
SLS Block 2 Crew
SLS Block 2 Cargo



ARTEMIS I

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

1. **LAUNCH**
   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 (TLI) BURN**
   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 (OTC) BURNS**
   As necessary adjust trajectory for lunar flyby to Distant Retrograde Orbit (DRO).
9. **OUTBOUND POWERED FLYBY (OPF)**
   60 nmi from the Moon; targets DRO insertion.
10. **LUNAR ORBIT INSERTION**
    Enter Distant Retrograde Orbit.
11. **DISTANT RETROGRADE ORBIT**
    Perform half or one and a half revolutions in the orbit period 38,000 nmi 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.
14. **RETURN TRANSIT**
    Return Trajectory Correction (RTC) burns as necessary to aim for Earth's atmosphere.
15. **CREW MODULE SEPARATION FROM SERVICE MODULE**
16. **ENTRY INTERFACE (EI)**
    Enter Earth's atmosphere.
17. **SPLASHDOWN**
    Pacific Ocean landing within view of the U.S. Navy recovery ship.

Artemis I Mission

- Launch windows:
  10/17-10/27
- Duration:
  26-42 days
- Total distance traveled:
  1.3M miles
- Re-entry speed:
  24.5K mph

Launch Update

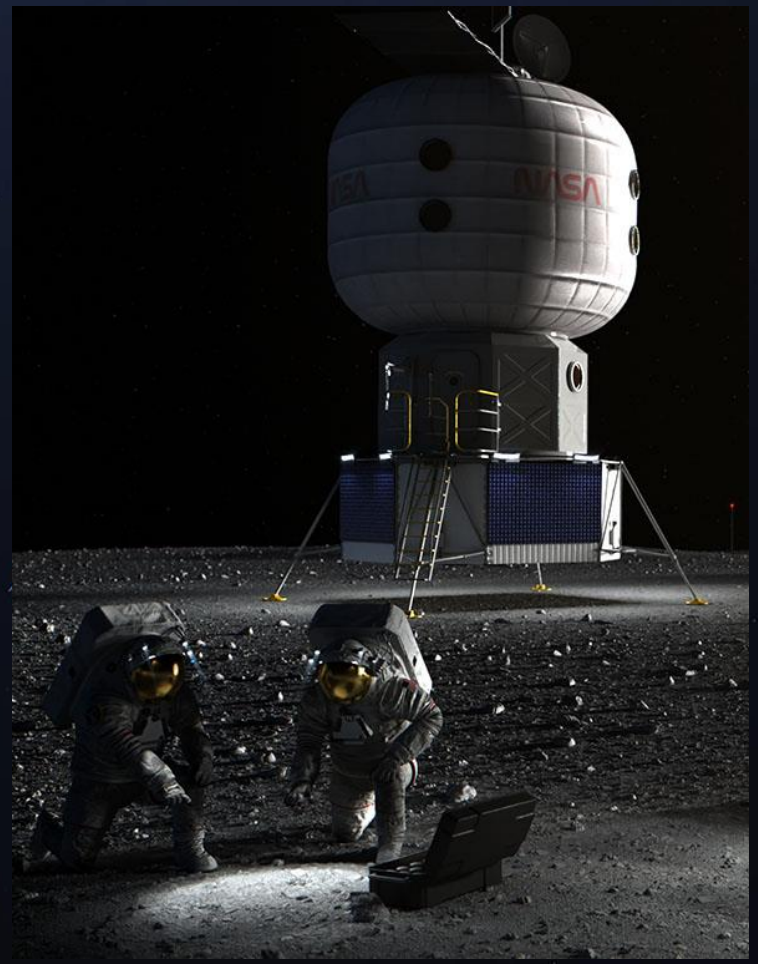
- 9/3 Launch scrubbed due to H2 leak
- 9/9 Repair of quick disconnect seals completed
- 9/21 Successful test to confirm repair of H2 leak
- 9/27 Launch canceled due to Tropical Storm Ian

How are we going to the moon?

- Space Launch System Rocket
- Orion Spacecraft
- Gateway
- Human Landing System

How are we going to the moon?

- Space Launch System Rocket
- Orion Spacecraft
- Gateway
- Human Landing System
- Artemis Base Camp



Questions ?