Stage Adapters: First flight hardware launched on Exploration Flight Test-1 in December 2014.

Interim Cryogenic Propulsion Stage: Currently in production.


Booster: Qualification Motor-1 test completed in March 2015.

Core Stage: First full set of flight rings completed; production is underway on barrels for EM-1.

Engines: RS-25 testing has begun at Stennis Space Center; renovations underway to B-2 stand.
JOURNEY TO MARS

HUBBLE
INTERNATIONAL SPACE STATION
SPACE LAUNCH SYSTEM (SLS)
ORBITERS
LANDERS
PHOBOS DEIMOS
ORION
SOLAR ELECTRIC PROPULSION
ASTERION REDIRECT MISSION
IN-SPACE HABITAT
MARS TRANSFER SPACECRAFT

MISSIONS: 6-12 MONTHS
RETURN: HOURS
EARTH RELIANT

MISSIONS: 1 TO 12 MONTHS
RETURN: DAYS
PROVING GROUND

MISSIONS: 2 TO 3 YEARS
RETURN: MONTHS
EARTH INDEPENDENT

EXPLORATION
SCIENCE
TECHNOLOGY
COMMERCIAL CARGO AND CREW
Early Proving Ground Objectives

- **Demonstrate SLS and Orion in deep space**
  - Critical Mission Events
    - Separation Events, Key Maneuvers, Re-entry, Landing and Recovery
  - Co-manifested cargo capability with Orion incl. loads, dynamics
  - Demonstrate integrated vehicle systems in flight
    - Deep space communications, power and thermal systems, in-space maneuvering
  - Validate environments
  - Autonomous operations

- **Conduct EVAs in deep space, micro-g environments**
- **Conduct human and robotic mission operations**
- **Evaluate crew health and performance in a deep space environment**
- **Demonstrate Solar Electric Propulsion (SEP) systems**
- **Demonstration of In-Situ Resource Utilization in micro-g**
- **Learn to operate with reduced logistics capability**
- **Demonstrate long duration, deep space habitation systems**
- **Demonstrate structures & mechanisms**
  - Low temperature and mechanisms for long duration, deep space missions
  - Inflatable structures
Game-changing Power For Exploration

- Human Missions to Mars
- Ultra-Large Space Telescopes
- Mars Sample Return
- Europa Exploration
- Interstellar Probe
- Asteroid Redirect Mission
- NASA's Space Launch System
- Space Stations
- Enceladus Geyser Sample Return
• SLS initial configuration offers Block 1 to LEO.

• Future configurations offer Block 1B and Block 2 to LEO.

• Mass capability benefits mean larger payloads to any destination.
SLS Characteristic Energy

- SLS Block 1 - Orion + iCPS
- SLS Block 1 - 5.0m Fairing + iCPS
- SLS Block 1B - 8.4m Fairing + EUS
- SLS Block 2B - 8.4m Fairing + EUS + Advanced Boosters (min-max)
- Existing Launch Vehicles
- Europa Class Mission

Net Payload System Mass (mt)

Characteristic Energy, C3 (km²/s²)

- Lunar
- Mars
- Jupiter
- Saturn via JGA
- Saturn/ Uranus Direct
- Europa Class Mission
- EM-1
Europa Trajectory Comparison

**Atlas V 551: VEEGA**

- VGA (5/14/22)
- EGA-1 (10/24/23)
- EGA-2 (10/24/25)
- Launch (11/21/21)
- JOI (4/4/28)

**Jupiter’s Orbit**

**SLS: Direct**

- Launch (6/5/22)
- DSM (7/10/22)
- JOI (5/23/24)

**REDUCES TRANSIT TIME TO EUROPA BY HALF**
SLS Payload Configurations

Mission concepts with 5m fairing
- Europa Clipper
  total mission volume = ~ 300m³

Mission concepts with Universal Stage Adaptor (includes additional payload capability)
- Orion with EAM
  total mission volume = ~ 400m³
- Orion with ARV
  total mission volume = ~ 400m³
- 5m fairing w/Robotic Lunar Lander & EAM
  total mission volume = ~ 600m³

Mission concepts with 8m and 10m fairings
- 8m fairing with ATLAST
  total mission volume = ~ 1200m³
- 10m fairing w/notional Mars payload
  total mission volume = ~ 1800m³
Secondary Payload Capability

- Eleven 6U/12U payload locations
- 6U volume/mass is the current standard (14 kg payload mass)
- Payloads will be “off” from roll-out through Orion separation and payload deployment
- Payload Deployment System Sequencer; payload deployment will begin with pre-loaded sequence following MPCV separation and ICPS disposal burn
- Payload requirements captured in Interface Definition and Requirements Document

Advanced Exploration Systems candidate EM-1 payloads include:

- BioSentinel: Study radiation-induced DNA damage of live organisms in cislunar space; correlate with measurements on ISS and Earth.
- Lunar Flashlight: Locate ice deposits in the moon’s permanently shadowed craters
- Near Earth Asteroid (NEA) Scout: Flyby/rendezvous and characterize one NEA that is a candidate for a human mission.
Summary

• **SLS provides capability for human exploration missions.**
  - Block 1 configuration enables initial flight tests.
  - Evolved configurations enable missions including humans to Mars.

• **SLS offers unrivaled benefits for a variety of missions.**
  - Block 1 provides greater mass lift than any contemporary launch vehicle; Block 2 offers greater lift than any launch vehicle, ever.
  - With 8.4m and 10m fairings, SLS will offer greater volume lift capability than any other vehicle.
  - Initial ICPS configuration and future evolution will offer highest-ever C3.

• **SLS is currently on schedule for first launch.**
  - Preliminary design completed in July 2013; SLS is now in implementation.
  - Manufacture and testing are currently underway.
  - Hardware now exists representing all SLS elements.