National Aeronautics and Space Administration

Launching to the Moon and Beyond

www.nasa.gov

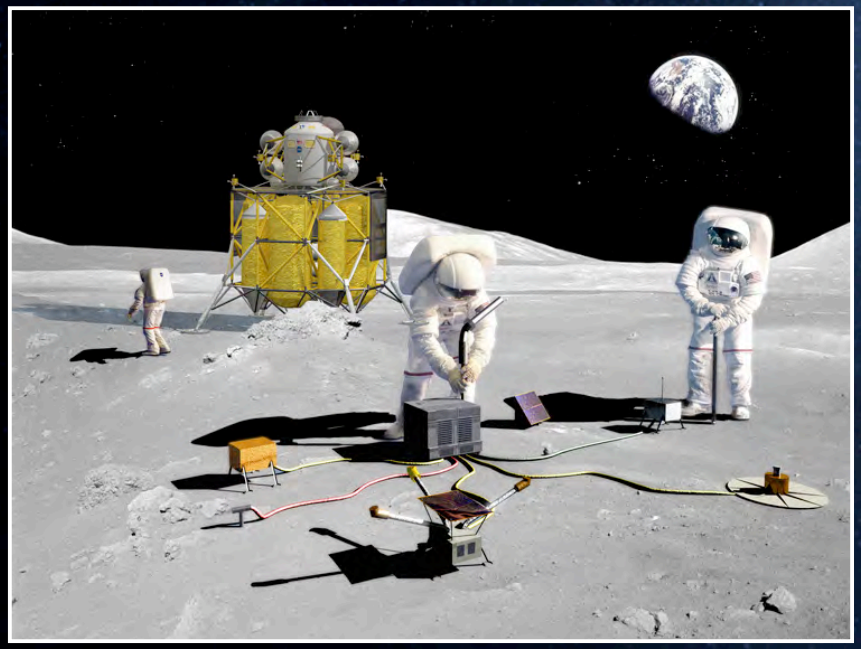
061308

Today's Journey

- What is NASA's mission?
- Why do we explore?
- What is our time line?
- Why the Moon first?
- What will the vehicles look like?
- What progress have we made?
- Who is on our team?
- What are the benefits of space exploration?

What is NASA's Mission?

- **Safely fly the Space Shuttle until 2010**
- **Complete the International Space Station (ISS)**
- **Develop a balanced program of science, exploration, and aeronautics**
- **Develop and fly the Orion Crew Exploration Vehicle (CEV)**
  - Designed for exploration but will initially service ISS
- **Land on the Moon no later than 2020**
- **Promote international and commercial participation in exploration**

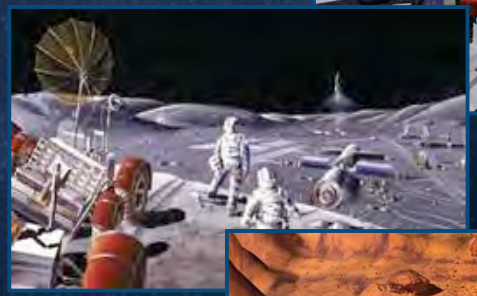


"The next steps in returning to the Moon and moving onward to Mars, the near-Earth asteroids, and beyond, are crucial in deciding the course of future space exploration. We must understand that these steps are incremental, cumulative, and incredibly powerful in their ultimate effect."

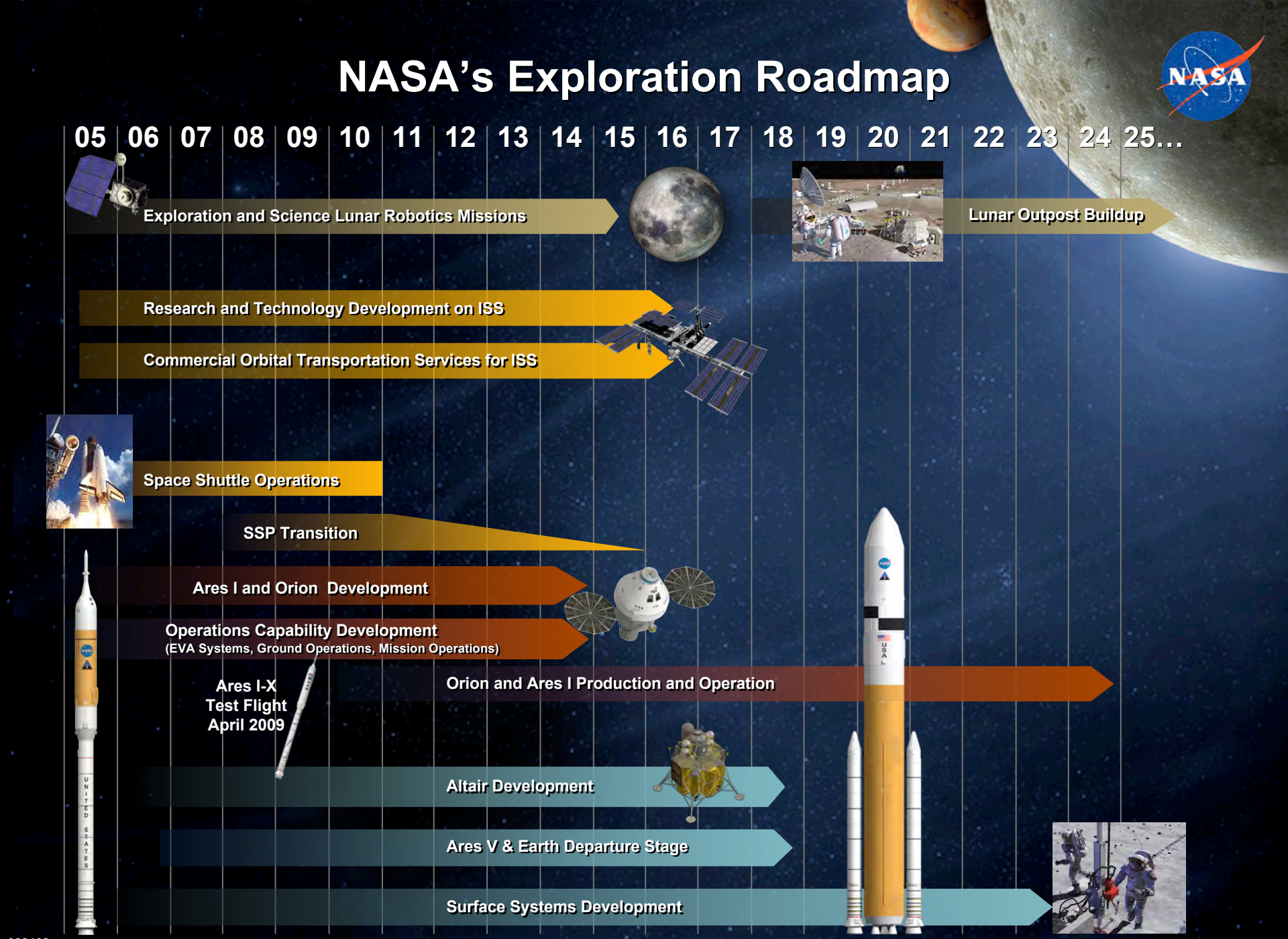
– NASA Administrator Michael Griffin
October 24, 2006

Why Do We Explore?

- **Inspiration**
  - Inspire students to explore, learn, contribute to our nation's economic competitiveness, and build a better future
- **Innovation**
  - Provide opportunities to develop new technologies, new jobs, and new markets
- **Discovery**
  - Discover new information about ourselves, our world, and how to manage and protect it



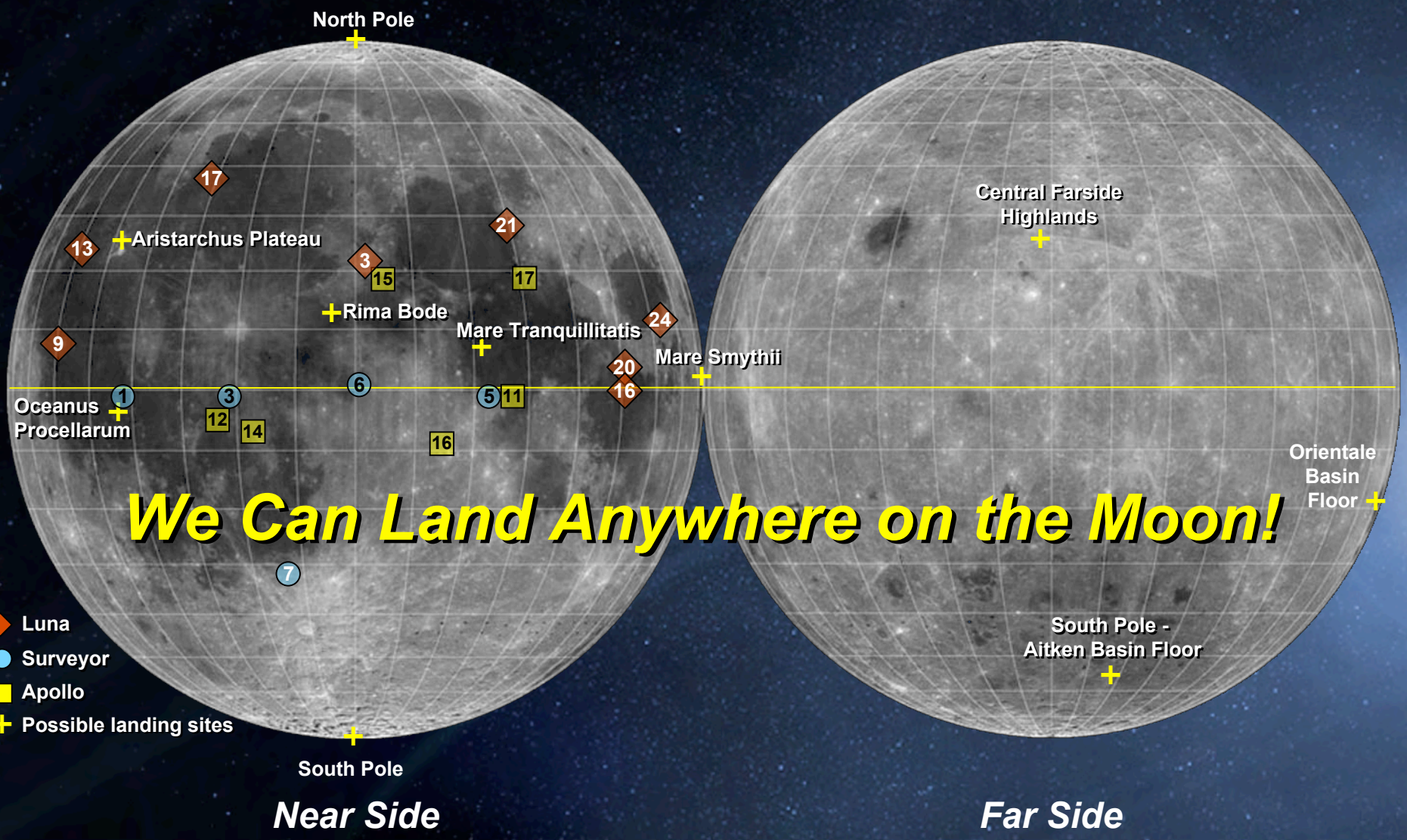
NASA's Exploration Roadmap



Why the Moon Next?

- It's close (3 days) and accessible –Geosynchronous Earth Orbit (GEO)
- Alien yet familiar; Earth is visible to crew and TV audiences
- Moon can be reached with existing or derived launch systems
- Transport system to Moon can also access GEO, cis-Lunar, Earth-Sun Lagrangians, and some asteroids
- Retire risk to future planetary missions by re-acquiring experience and testing with lunar missions
- Development of lunar resources has potential to be a major advancement in space logistics capability
- Advance science, improve engineering state-of-the-art, inspire country

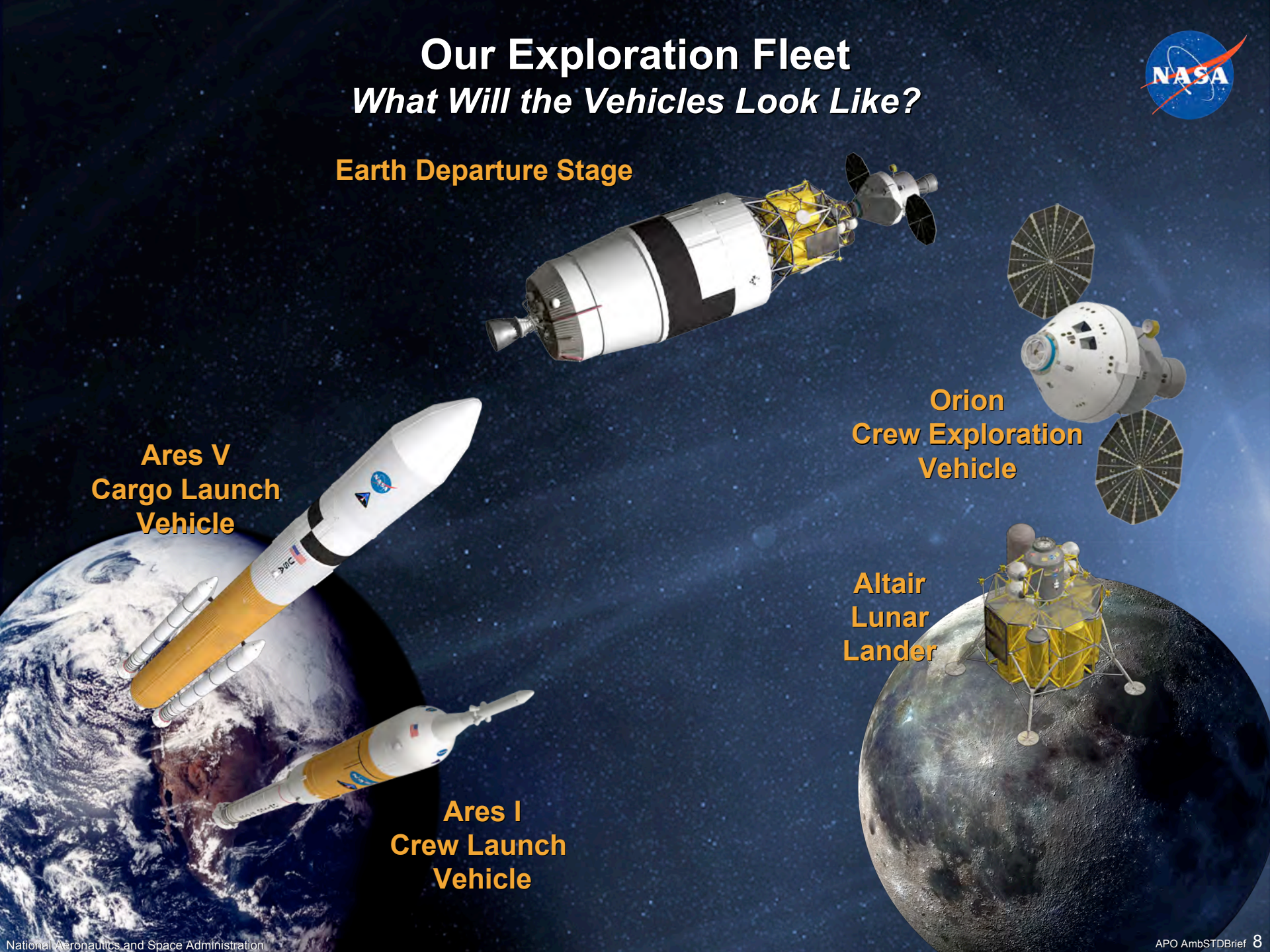
There Are Many Places To Explore



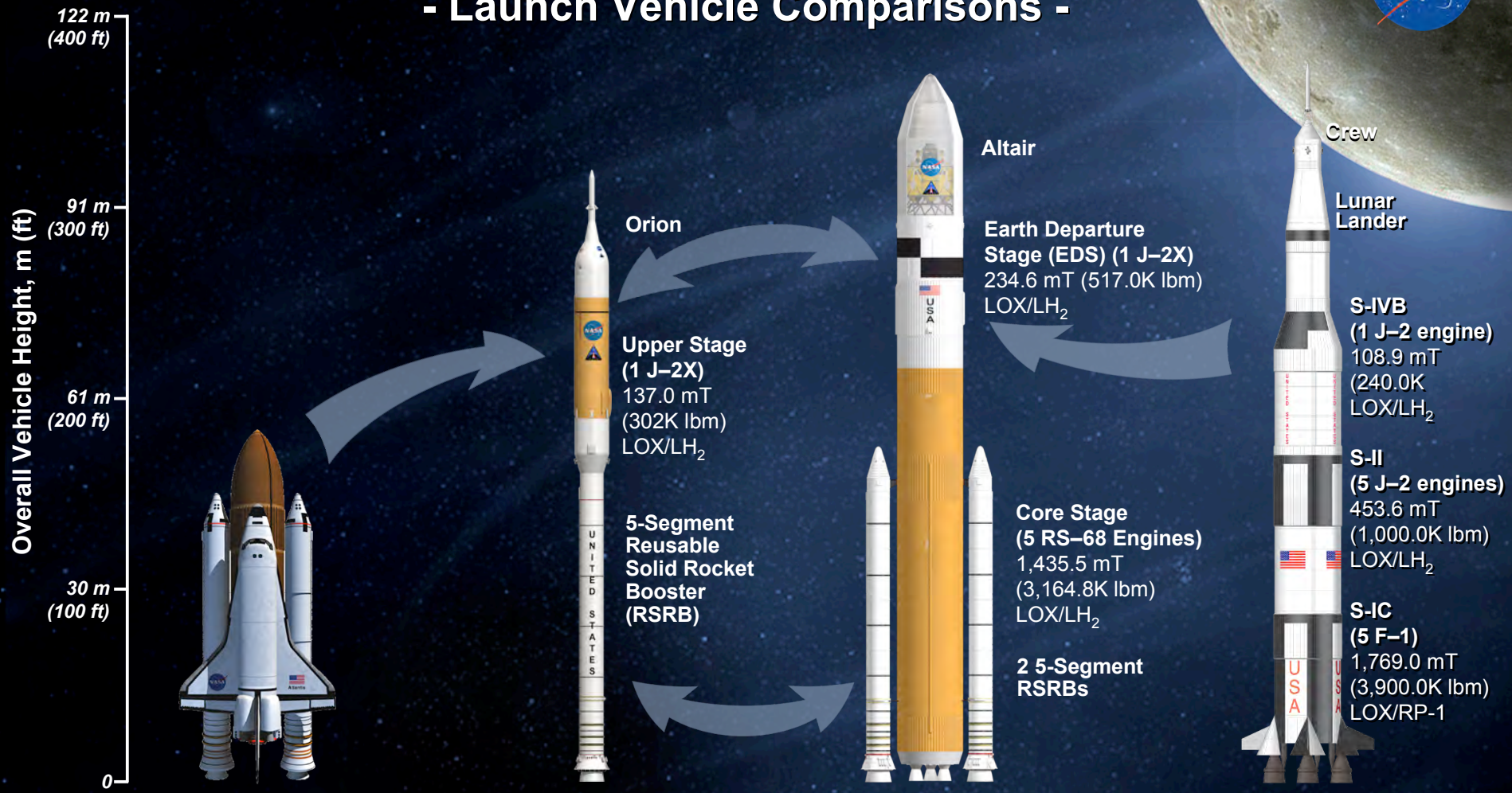
We Can Land Anywhere on the Moon!

Our Exploration Fleet

What Will the Vehicles Look Like?



Building on a Foundation of Proven Technologies
- Launch Vehicle Comparisons -



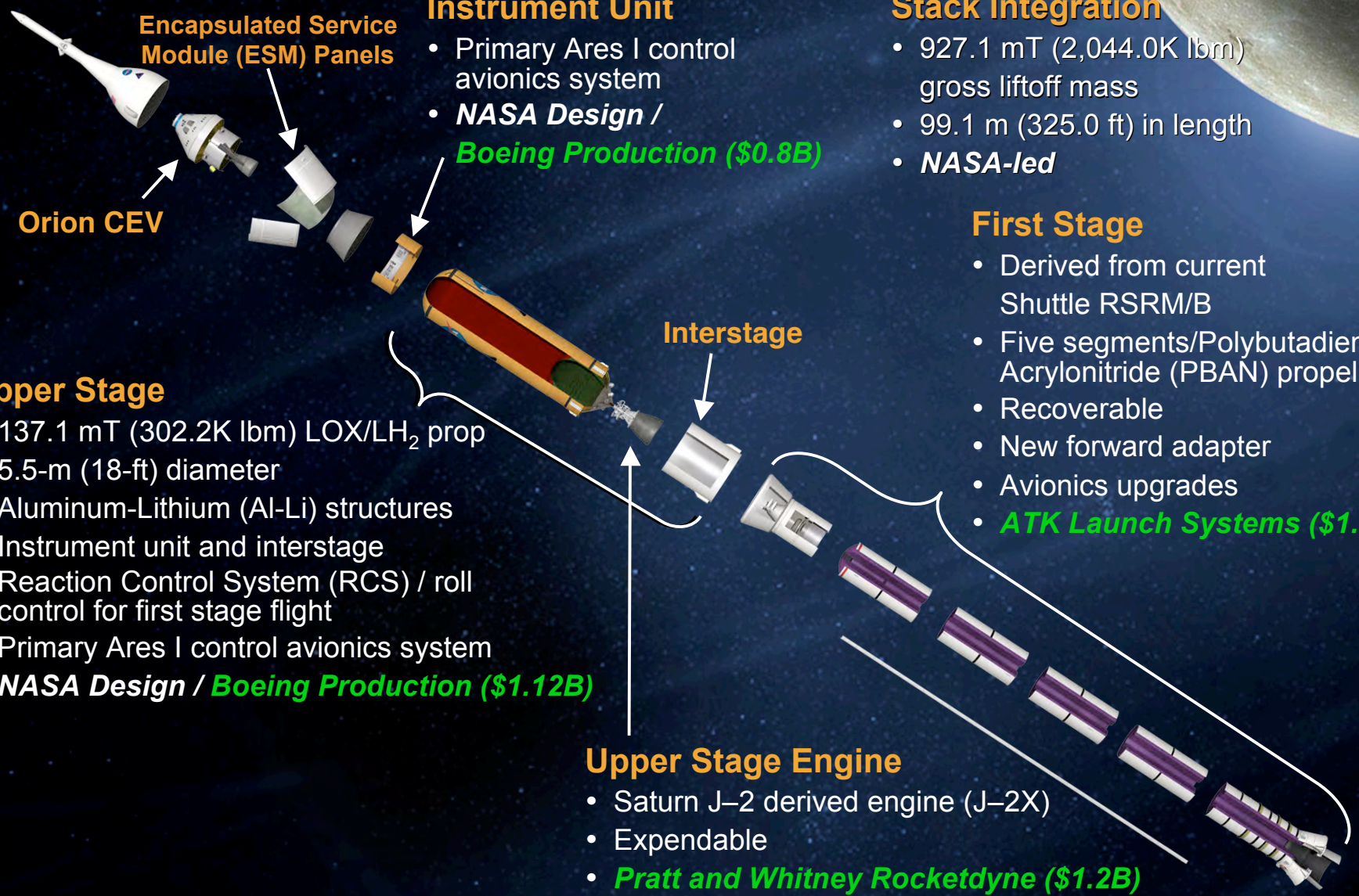
Space Shuttle
Height: 56.1 m (184.2 ft)
Gross Liftoff Mass:
2,041.1 mT (4,500.0K lbm)
Payload Capability:
25.0 mT (55.1K lbm) to Low Earth Orbit (LEO)

Ares I
Height: 99.1 m (325 ft)
Gross Liftoff Mass:
927.1 mT (2,044.0K lbm)
Payload Capability:
25.5 mT (56.2K lbm) to LEO

Ares V
Height: 109.9 m (360.5 ft)
Gross Liftoff Mass:
3,374.3 mT (7,439.6K lbm)
Payload Capability:
63.7 mT (140.5K lbm) to TLI (with Ares I)
55.6 mT (123K lbm) to Direct TLI
~143.4 mT (316K lbm) to LEO

Saturn V
Height: 110.9 m (364 ft)
Gross Liftoff Mass:
2,948.4 mT (6,500K lbm)
Payload Capability:
44.9 mT (99K kbm) to TLI
118.8 mT (262K lbm) to LEO

Ares I Elements



Instrument Unit

- Primary Ares I control avionics system
- ***NASA Design / Boeing Production ($0.8B)***

Stack Integration

- 927.1 mT (2,044.0K lbm) gross liftoff mass
- 99.1 m (325.0 ft) in length
- ***NASA-led***

First Stage

- Derived from current Shuttle RSRM/B
- Five segments/Polybutadiene Acrylonitride (PBAN) propellant
- Recoverable
- New forward adapter
- Avionics upgrades
- ***ATK Launch Systems ($1.8B)***

Upper Stage

- 137.1 mT (302.2K lbm) LOX/LH_2 prop
- 5.5-m (18-ft) diameter
- Aluminum-Lithium (Al-Li) structures
- Instrument unit and interstage
- Reaction Control System (RCS) / roll control for first stage flight
- Primary Ares I control avionics system
- ***NASA Design / Boeing Production ($1.12B)***

Upper Stage Engine

- Saturn J–2 derived engine (J–2X)
- Expendable
- ***Pratt and Whitney Rocketdyne ($1.2B)***

Orion Crew Exploration Vehicle

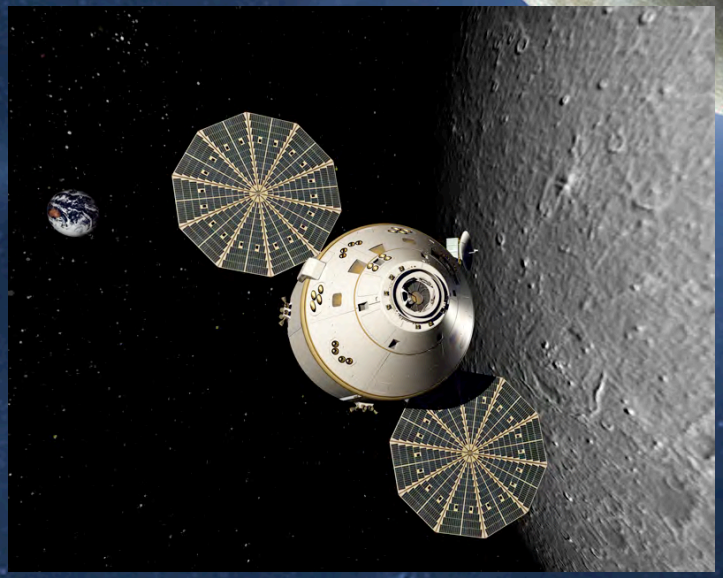
Launch Abort System

Attitude Control Motor
(Eight Nozzles)

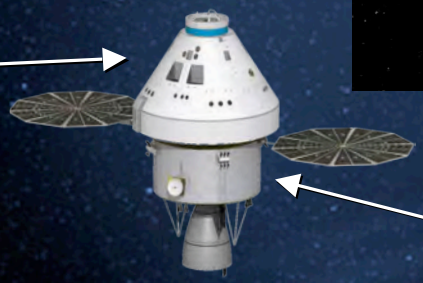
Canard Section
(Stowed Configuration)

Jettison Motor
(Four Aft, Scarfed Nozzles)

Abort Motor
(Four Exposed, Reverse Flow Nozzles)



Crew Module



Service Module

LOCKHEED MARTIN

Encapsulated Service Module (ESM) Panels

Spacecraft Adapter

Volume: 115.8 m^3 (380 ft^3)
- 80% larger than Apollo

Diameter: 5.0 m (16.4 ft)

Ares V Elements

Stack Integration

- 3,374.5 mT (7,439.6 lbm) gross liftoff mass
- 110 m (361 ft) in length

Solid Rocket Boosters

- Two recoverable 5-segment PBAN-fueled boosters (derived from current Ares I first stage)

Core Stage

- Five Delta IV-derived RS–68 LOX/LH_2 engines (expendable)
- 10-m (33-ft) diameter stage
- Composite structures
- Aluminum-Lithium (Al-Li) tanks

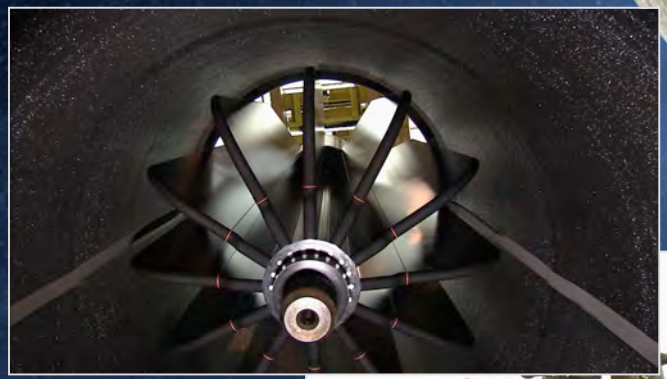
Earth Departure Stage (EDS)

- One Saturn-derived J–2X LOX/LH_2 engine (expendable)
- 10-m (33-ft) diameter stage
- Aluminum-Lithium (Al-Li) tanks
- Composite structures, instrument unit and interstage
- Primary Ares V avionics system

Journey to the Moon

What Progress Have We Made?

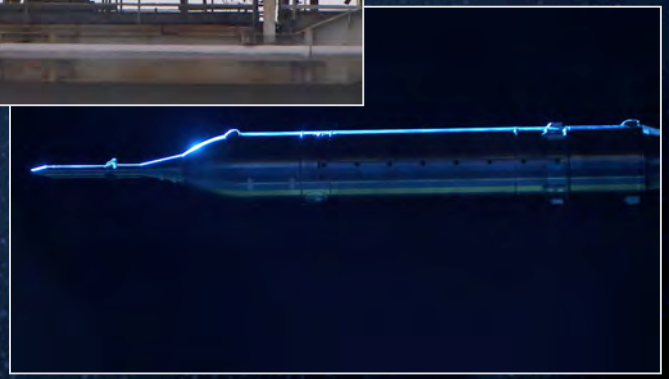
- **Programmatic Milestones**
  - Completed Ares I System Requirements Reviews
  - Contracts awarded for building the first stage, J–2X engine, upper stage, instrument unit, and Orion
  - Completed Ares I System Definition Review
  - Ares I–X test flight scheduled for April 2009
- **Technical Accomplishments**
  - Testing first stage parachutes and developing nozzles
  - Constructing new J–2X test stand at Stennis Space Center
  - Performing J–2X injector tests and power pack tests
  - Fabricating Ares I–X hardware
  - Testing in wind tunnels



Dry-fit of Forward Segment Propellant Core

Cutting Dome Gore Panels for LH_2 Tank

Powerpack 1A at SSC



ADAC-2B Wind Tunnel Testing

For more information go to www.nasa.gov/ares

Ares I–X Test Flight

- **Demonstrate and collect key data to inform the Ares I design:**
  - Vehicle integration, assembly, and KSC launch operations
  - Staging/separation
  - Roll and overall vehicle control
  - Aerodynamics and vehicle loads
  - First stage entry dynamics for recovery

- **Performance Data:**

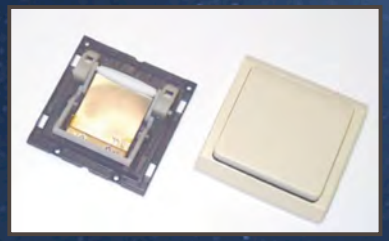
	Ares I-X	Ares I
First Stage Max. Thrust (vacuum):	14.1 MN	15.8 MN
Max. Speed:	Mach 4.7	Mach 5.84
Staging Altitude:	39,600 m (130 ft)	57,700 m (188 ft)
Liftoff Weight:	816 mT (1,799 lbm)	927 mT (2,044 lbm)
Length:	99.7 m (327 ft)	99.1 m (325 ft)
Max. Acceleration:	2.46 g	3.79 g

Ares Nationwide Team

Down-to-Earth Benefits from the Space Economy

NASA powers innovation that creates new jobs, new markets, and new technologies.

- **Personal Health**
  - Eye tracker for LASIK surgery
  - Breast biopsy system
- **Consumer Products**
  - Wireless light switch
  - Remote appliance programmer
  - Global Positioning Systems (GPSs)
- **Environmental**
  - Water Filtration system
  - Environmentally friendly chemical cleanup
- **Security**
  - Stair-climbing tactical robot
  - Crime scene video enhancement



For more information see http://technology.jsc.nasa.gov

Every Dollar Invested in Space is Spent on Earth.

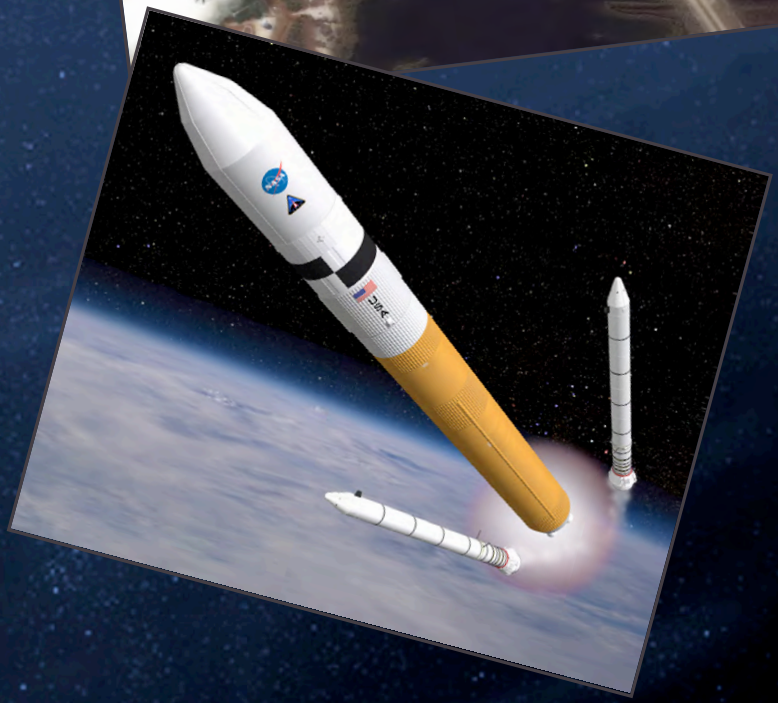
NASA Explores for Answers that Power Our Future

NASA powers inspiration that encourages future generations to explore, learn, and build a better future

- **NASA relies on a well-educated U.S. workforce to carry out missions of scientific discovery that improve life on Earth**
- **America's technological edge is diminishing**
  - Fewer engineering graduates from U.S. colleges and universities
  - More engineering and science graduates in other countries
- **The global marketplace is increasingly competitive and technology-driven**
- **Students need motivating goals and teachers with information to share**
- **NASA continues to develop educational tools and experiences that inspire, educate, and motivate**
- **Space exploration offers new economic opportunities through technology and resource development**

Summary

- **The Ares family will provide the U.S. with unprecedented exploration capabilities**
  - Can inject ~40% more mass to the Moon than Apollo/Saturn
- **The Ares team has made significant progress since its inception in October 2005**
  - Full team is onboard
  - All major milestones met to-date, with PDR scheduled for late Summer 2008
  - Ares I–X test flight is on schedule for April 2009
- **We are making extensive use of lessons learned to minimize cost, technical, and schedule risks**
- **The NASA-led / Contractor partnership is very effective in developing the Ares I**



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