



- Welcome, and thank you for taking this time with me. I would like to share with you some of the exciting things being done by *your* space program.



- Today, I will be explaining:
 - What NASA's mission is;
 - Why we explore;
 - What our time line is;
 - Why we will explore the Moon first;
 - What the vehicles will look like;
 - What progress we have made toward launch and exploration;
 - Who comprises our team; and
 - How space exploration will benefit you.

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.”

*-Former NASA Administrator
Michael Griffin
October 24, 2006*

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- NASA's mission includes:
 - Completing the International Space Station (ISS);
 - Retiring the Space Shuttle; and
 - Building the new safe, reliable, and cost-effective space transportation system needed to explore the Moon and go on to Mars, all while continuing to perform world-class science.
- This strategy commits NASA and the nation to an agenda of exploration for the purposes of national security, economic prosperity, and technological leadership in the 21st century.
- Alongside this effort, we will continue developing robotic explorers and technologies that meet the challenges ahead, while developing the infrastructure that will enable us to pioneer the new frontier.

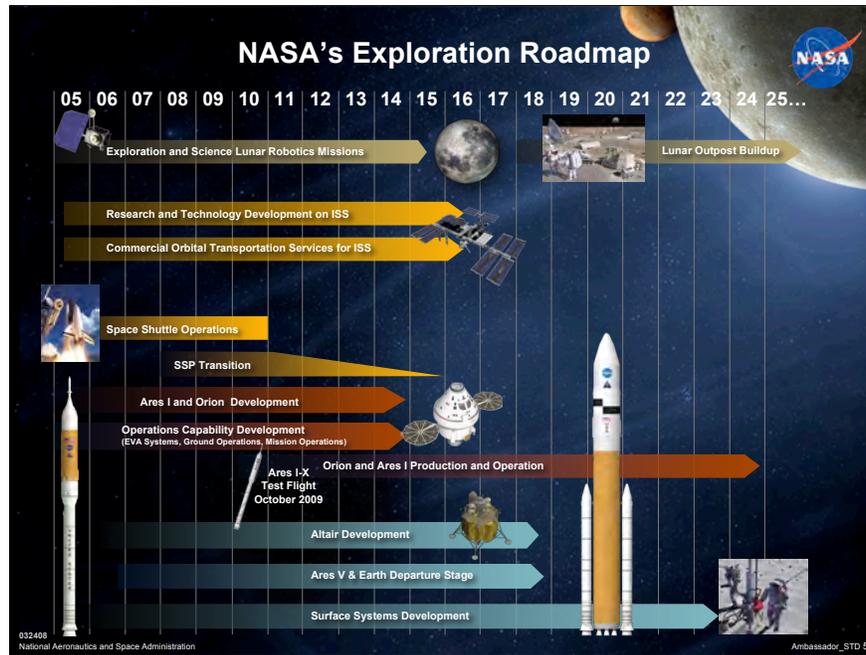
Why Do We Explore?



- ◆ **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

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- The U.S. Space Exploration Policy is to develop a long-term human presence on the Moon and other destinations. We are already starting to build the hardware that will get us there. But before I talk about how we are going to get there, I believe it is more important to discuss why we are going.
- NASA is pursuing three primary outcomes: inspiration, innovation, and discovery.
- When it comes to inspiration, we are drawing on our experience with Apollo and Shuttle, which inspired a generation of young people to study science, technology, engineering, and mathematics, and to reach for greater goals.
 - NASA and the nation will continue to need skilled, hard-working people to keep us on the cutting edge of technology and exploration.
- Journeys to the Moon and beyond fuel innovation for our nation by providing opportunities to develop new technologies.
 - Going into and exploring space requires cutting-edge technologies.
 - Technologies used to explore space often find applications here on Earth—but we need to explore first to make those technologies a reality.
 - Exploration technologies create economic growth and opportunities here at home.
- And finally, when we travel to places we haven't been before, we discover new information about the universe that improves and teaches us about life on Earth.
 - By going to the Moon and beyond, we will learn more about the formation, current state, and future of our own world.
 - Our solar system offers new potential resources, including materials for industry and energy for our daily lives.



- This next phase of space exploration will be “a journey, not a race,” though we do have rivals in space exploration.
- We must challenge ourselves to develop these vehicles and their infrastructure incrementally, deliberately, and **within our means**.
- In 1966, at the height of the Apollo program, NASA received 4 percent of the federal budget. Today, with less than 1% of the budget (15 cents per day per American), we are working smarter, using modern engineering tools while applying 50 years of hard-won lessons. The schedule you see here reflects those realities.
- The timelines for our mission activities show Space Shuttle operations continuing through 2010, with demonstrations of commercial launches to the International Space Station beginning at that time.
- Following the first launch of the Ares I-X test flight in 2009 and the first human flight in 2014, the Ares I crew launch vehicle is scheduled for its first mission to the International Space Station in 2015. From 2010 when the Shuttle retires until 2015, we will continue to depend on our Russian partners to provide crew and cargo launches.
- The first flight of Ares V will be in 2018. We anticipate the next human landing on the Moon to occur by 2020.
- Once these systems are operational, Ares I will fly to the International Space Station twice a year. Likewise, Ares V comes online, Ares I and V will combine to make two trips a year to the moon.

The Moon

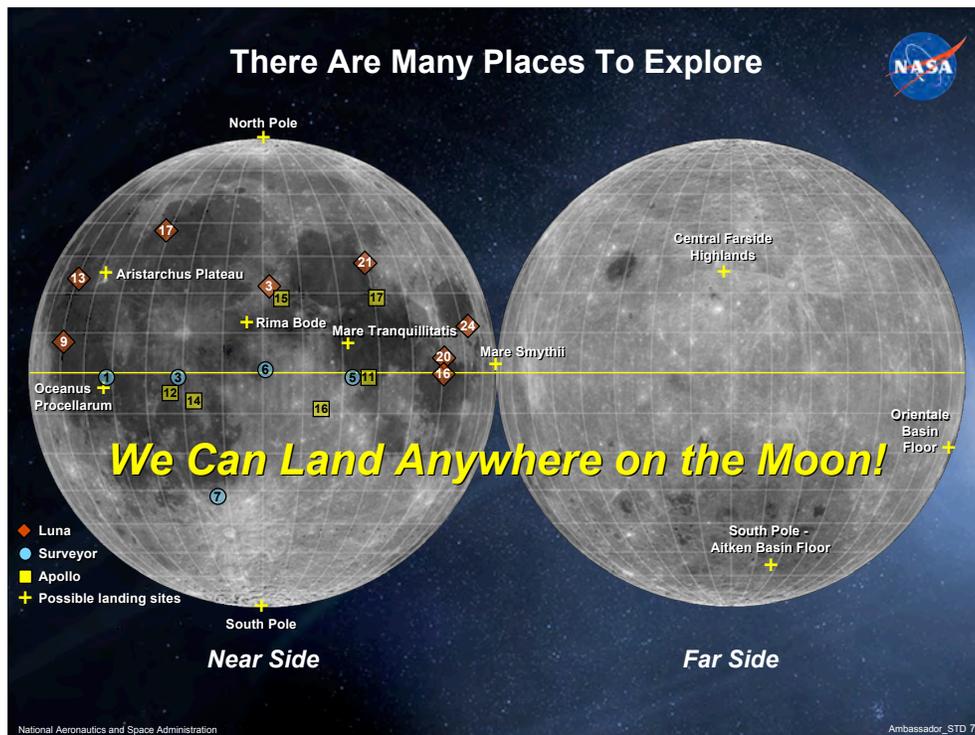
- ◆ **Lunar missions allow us to:**
 - Gain exploration experience
 - Space no longer a short-term destination
 - Will test human support systems
 - Use Moon to prove ability to build and repair long-duration space assets
 - Develop exploration technologies
 - Launch and exploration vehicles
 - In-situ resource utilization
 - Power and robotic systems
 - Conduct fundamental science
 - Astronomy, physics, astrobiology, geology, exobiology




The Next Step in Fulfilling Our Destiny as Explorers

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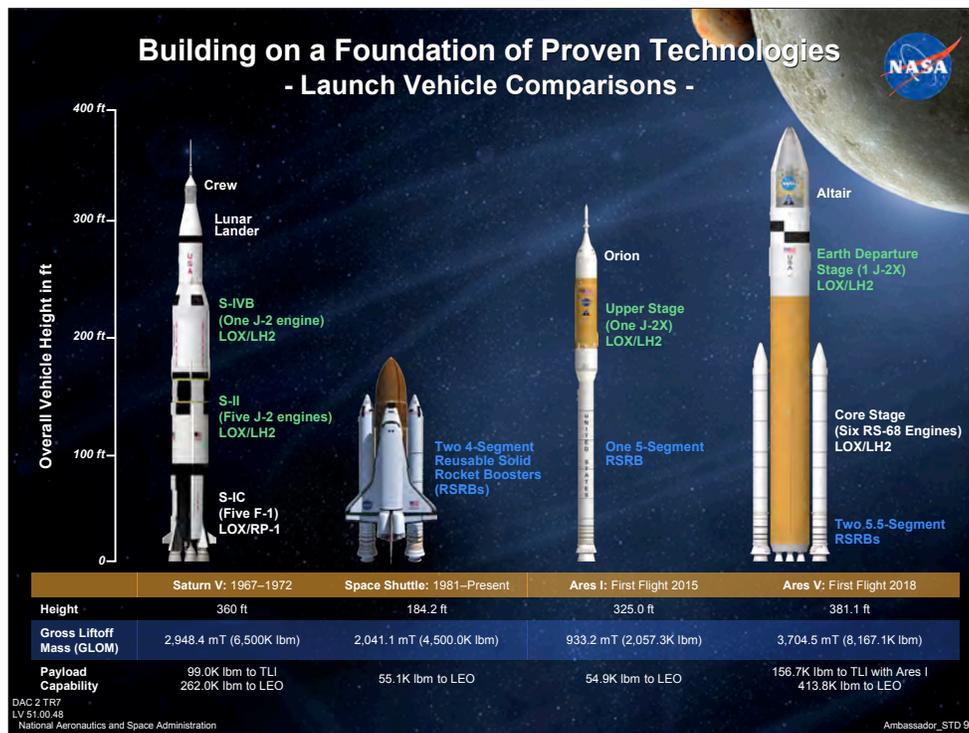
- There have been many paper studies and books suggesting how we could go to Mars directly. So why are we going to the Moon first?
 - Because we need to build a foundation of experience by proving ourselves and new, long-duration exploration technologies closer to home before we take on the much bigger job of going to Mars.
 - Going to the Moon is still very difficult all by itself; and, while lunar missions will require as few as 7 days, missions to Mars will take months.
 - Every part and person in the Apollo Program had to work perfectly to ensure safe landings on the Moon. But, even with extremely reliable machines, everything did not work perfectly. We still got there and back because of having humans in the loop. Every mission, even the most successful, was a true test of humans and machines.
 - In reaching for the Moon, we will answer important scientific questions and will teach ourselves ways to explore, use local resources, and repair our machinery, while remaining close to home.



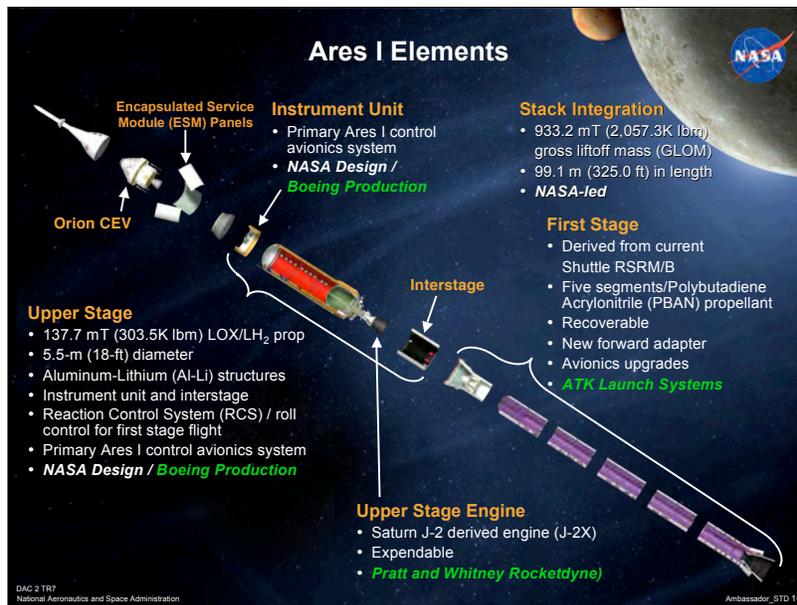
- Unlike the Apollo/Saturn missions, which took place in locations near the Lunar equator, the Ares/Orion missions will support a Lunar Lander, Altair, that can land anywhere on the Moon. This will be an important capability because exciting discoveries were made by robotic explorers in the 1990s which suggest that hydrogen—in the form of water ice—might be located at the lunar poles.
- One possible site for placing a future lunar outpost would be the rim of Shackleton Crater near the Lunar South Pole. This location:
 - Has high concentrations of hydrogen based on remote sensing data from Lunar Prospector and Clementine;
 - Is in daylight for over 80% of the lunar month, making it supportable by solar power;
 - May have ice that could be used to manufacture water itself, as well as breathing oxygen for a permanent base and hydrogen and oxygen for rocket fuel;
 - Is of interest to scientists because it is within the immense South Pole-Aitken Basin, the largest known impact crater in the solar system (12 km deep); and
 - Is on the far side of the Moon where humans have never visited.
- While future robotic explorers (LCROSS and Lunar Reconnaissance Orbiter (LRO)) will give us more information about the nature of hydrogen on the Moon, it will most likely take a human being walking around with a rock hammer to find the real evidence and put together a true picture of what is there.



- The journey to the Moon will require a variety of vehicles, including the Ares I crew launch vehicle, the Ares V cargo launch vehicle, the Orion CEV, and the Altair lunar lander.
- The architecture for lunar missions will use two launches, with the Ares V transporting the Altair lunar lander and the Earth departure stage (EDS), followed by Ares I transporting the crew.



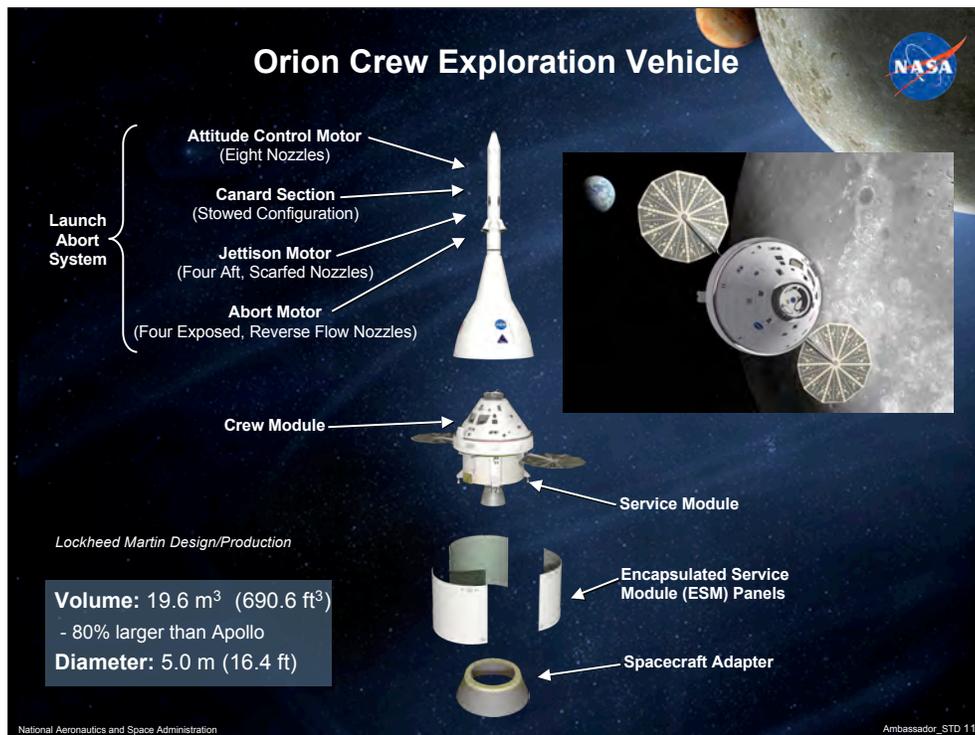
- This slide compares Ares I and Ares V to the Space Shuttle and Saturn V in height and payload. The arrows show where hardware developed for the earlier systems is being adapted to meet our current needs. This is a cost and time savings, as we can use existing manufacturing techniques and personnel to build hardware. Proven hardware designs like these also increase vehicle safety and reliability.



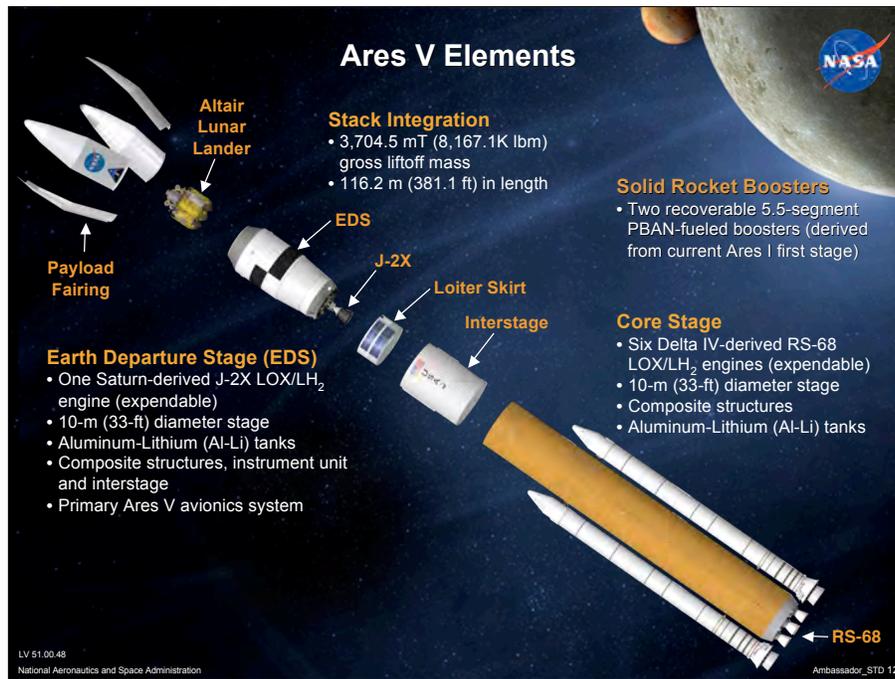
•Ares I is a big vehicle. At a height of over 300 feet, it is almost 75 percent taller than the Space Shuttle stack. It has an “in-line” configuration, as opposed to the Shuttle, which has the orbiter and crew placed beside the External Tank. In the event of an emergency, the Orion Crew Module can be blasted away from the launch vehicle using the Launch Abort System (LAS), which will fly directly upward, out of the way of the launcher. This makes Ares I more than ten times safer than the Shuttle. In addition to the LAS, upper stage, and first stage, which I have already discussed, the stack includes a forward skirt and instrument unit, which connects the Orion to the Ares I and contains the flight computer for controlling the launch vehicle. The Upper Stage and First Stage are connected by the Interstage. The Interstage also contains roll control thrusters to prevent the vehicle from spinning as it accelerates upward from the thrust of the RSRB.

•**Optional Details**

- Ares I Length 325 ft.
- 5 Segment First Stage, which takes the vehicle up to about 250,000 feet
- Upper Stage
 - 18.2 ft. diameter with 305,000 lbm usable propellant
- J-2X Engine - 448 ISP, 294,000 lbf thrust
 - J-2X is an evolution of the J-2 engine was used in Apollo
 - Most recently, upgraded turbopumps were tested as part of the aerospike engine for the X-33 program
- -11 X 100 nmi insertion Orbit
 - 28.5 Inclination (Lunar)
 - 51.6 Inclination (ISS)
 - The Upper Stage is jettisoned at an altitude of 70 nautical miles
- Roll Control divided between 1st Stage and Upper Stage
- Critical Separation between 1st Stage and US occurs at the forward interstage
- Bolted Interface with CEV (16.4 ft. diameter)



- The purpose of the Ares launch vehicles is to get human beings and their equipment into space. NASA's primary crew exploration vehicle will be the Orion.
- Orion has a Crew Module (CM) modeled after the Apollo Command Module, but it will have more than twice as much interior space. It consists of two parts, the CM and the Service Module (SM).
- The CM houses the crew and supplies and includes the primary controls for the spacecraft.
- The SM houses the propulsion system, provides electrical power, and stores liquid water for the crew.
- The Orion system also includes a spacecraft adapter for attaching the vehicle to Ares I and the LAS, which can fire its rockets in emergencies to lift the CM up and away from the Ares I. During this 2-sec firing, the crew experiences an acceleration of up to 15 Gs.
- Orion will be able to transport up to six crew members or pressurized cargo to the ISS or up to four crew members to the Moon. On a lunar mission, it docks with the Altair lunar lander and EDS, fires its main engine for Lunar Orbit Insertion (LOI), and then flies in orbit autonomously while the crew descends to the surface in the lander.
- When the crew returns from the surface, the lander is expended, and Orion provides the impulse for the journey home. Prior to re-entering Earth's atmosphere, the SM is jettisoned, and the CM returns the crew home to a landing on land or water.
- It may even be possible to reuse the CM after a mission. This has the potential to reduce costs because the equipment onboard is very expensive and sophisticated.



- As big as the Ares I is, Ares V is bigger. Eighteen feet taller than the Saturn V, it is also nearly two million pounds heavier when fully loaded with fuel. The five-engine core stage will be the largest liquid-fueled rocket ever built. The vehicle's total thrust, including the two RSRBs, will be more than 11 million pounds, the equivalent of 46 747 aircraft.
- Atop the Core Stage is an Interstage, which connects the 33-foot-wide Core Stage with the 33-foot-wide Earth departure stage. These widths are significant because they are the same widths as the Saturn V which means we have demonstrated the capability to build 33-foot diameter stages during the Saturn program. The Instrument Unit will also include the launch vehicle's avionics computer.
- The J-2X engine powering the Earth departure stage must fire twice: once in the upper atmosphere to get the stage into orbit and again in orbit to send the Altair lunar lander and Orion toward the Moon. The Earth departure stage carries the Altair, which is covered by a payload shroud to protect it from atmospheric dynamics and heat. The shroud is jettisoned before the vehicle reaches orbit at a point where the air is thinner and aerodynamic forces are no longer a factor.
- **Additional Information**
 - The Ares V is powered by two 5.5-segment RSRBs and a core stage consisting of six RS-68 engines.
 - The RSRB is based on the current 4-segment Space Shuttle RSRB.
 - NASA test fired a five-segment RSRB in 2003.
 - The RS-68 is our most powerful and newest liquid hydrogen/liquid oxygen engine.
 - The RS-68 is in service today aboard the Delta IV Evolved Expendable Launch Vehicle (EELV) The Earth Departure Stage uses the same J-2X engine as Ares I.
 - On a typical mission, Ares V launches the Altair and Earth departure stage into orbit first, where it waits for the arrival of Orion, which is launched later aboard the Ares I.



- This video shows how all these pieces will fit together in a lunar mission.

What Progress Have We Made?

- ◆ **Programmatic Milestones**
 - Completed Ares I System Requirements Reviews, System Definition Review and Preliminary Definition Review
 - All Ares I Prime contractors on board
 - Ares I-X test flight scheduled for 2009
- ◆ **Technical Accomplishments**
 - Extensive testing on upper stage fuel tank panels
 - Full-scale upper stage demonstration hardware under construction
 - Ares I-X stacked at Kennedy Space Center

Workhorse Gas Generator Test

Nozzle Burnthrough Test

Inert Forward Segment X-Ray

Tank Barrel Structural Test

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

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- First, we are building the Ares I crew launch vehicle. This reduces the gap in human space flight capabilities following retirement of the Space Shuttle as much as possible.
- We have made tremendous progress on Ares I. Preliminary work on Ares V and the Altair Lunar Lander will continue until after Shuttle retirement in 2010.
- In late 2005, there was no vehicle. Now, just 3 years later, we have already completed two design cycles, confirmed our vehicle requirements, simulated vehicle behavior in wind tunnels and in computers, tested hardware and confirmed our design.
- Hardware testing and development includes:
 - Completed Ares I Preliminary Design Review (PDR) in September 2008, with unanimous approval from from the review board to continue detailed design.
 - Conducted a drop test of the drogue parachute with an 18-ton jumbo test vehicle.
 - Conducted first demonstration welds with the new robotic weld tool.
 - Completed the J-2X Critical Design Review (CDR), the first CDR of an operational component of the Constellation vehicle architecture.

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 (130K ft)	57,700 m (188K ft)
Liftoff Weight:	816 mT (1,799K lbm)	927 mT (2,044K lbm)
Length:	99.7 m (327 ft)	99.1 m (325 ft)
Max. Acceleration:	2.46 g	3.79 g

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- Ares I-X will be the first test flight of an Ares I crew launch vehicle, and it is scheduled for 2009. It will fly with a combination of functional and simulated hardware. The first stage will be a four-segment SRB from Shuttle inventory, which will include new forward structures to connect to the upper stage. The upper stage, Orion, and LAS will all be simulated hardware.
- Ares I-X is the first step in using an Apollo-type, multiple-step test strategy to:
 - Validate initial design models
 - Develop lessons learned into requirements
 - Enhance early learning about integration and hardware processing, leading to America's next generation of crew launch vehicles
- Ares I-X will give NASA its first opportunity to:
 - Gather critical data about the flight dynamics of the integrated launch vehicle stack
 - Understand how to control its roll during flight
 - Better characterize the severe stage separation environments that the upper stage engine will experience during future operational flights
 - Demonstrate the first stage recovery system
 - NASA also will begin to modify the launch infrastructure and to fine-tune ground and mission operations, as we make the transition from the Shuttle to the Ares/Orion system.
 - Hardware is being completed and delivered to KSC (12/08).



- Like Apollo, such a massive effort would be impossible without the cooperation and expertise of thousands of nationwide government and private-sector contractors throughout NASA's 10 centers.
- Additional points:
 - Our larger centers are taking on the bulk of the overall Constellation Program, which includes both the Orion and Ares vehicles:
 - Johnson Space Center (JSC) leads the development of Orion;
 - Kennedy Space Center (KSC) handles launch and recovery operations; and
 - Marshall Space Flight Center (MSFC) designs, develops, tests, and evaluates the Ares launch vehicles, including the Ares I-X flight test vehicle.
 - Other NASA locations are developing particular technologies and hardware for Constellation:
 - Ames Research Center (ARC) leads the effort to develop the Thermal Protection System (TPS) (heat shield) for Orion;
 - Dryden Flight Research Center (DFRC) leads the integration and operations for the Orion LAS flight test;
 - Jet Propulsion Laboratory (JPL) supports mission operations and the Orion TPS;
 - Langley Research Center (LaRC) leads the systems engineering and integration for Ares I-X, and has a role in developing the LAS for Ares I; and
 - Glenn Research Center (GRC) is building the segments for the Upper Stage Simulator of Ares I-X.

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.

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- NASA is powering innovation that creates new jobs, new markets, and new technologies.
- Not only are we writing the next chapter in America's history of adventure, but we are making more advances that improve life for everyone on Earth. People ask, "Why not spend money on problems here on Earth instead of spending the money on space?" When they ask this question, they overlook that the money is spent on Earth and many times specialized hardware developed for space exploration is turned toward Earth based purposes. For example: [cite a couple of the following examples]
- Personal Health
 - A technology for autonomous rendezvous and docking of space vehicles has resulted in a new eye-tracking device for LASIK surgery, called LADARTracker. LADARTracker measures eye movements 4,000 times per second, making the procedure much safer and more precise.
 - Charge Coupled Devices (CCDs) used on the Hubble Space Telescope convert light directly into electronic or digital images that can be manipulated and enhanced by computers. A commercial version of the Hubble device is part of a new, non-surgical and much less traumatic breast biopsy technique that saves time and money and reduces scarring.
- Consumer Products
 - LaRC engineers researching food growth within closed environments—such as the Space Shuttle and the International Space Station—developed a low-cost device that creates electrical energy out of mechanical energy. It is now in widespread use as a wireless light switch
 - A remote command and control system designed to help NASA run experiments on the ISS led to an intelligent oven that consumers can program to start cooking before they get home, via a cell phone, Personal Digital Assistant (PDA,) or Internet connection.
 - Global Positioning Systems (GPSs) originally designed for military purposes are now part of navigation systems used in by drivers, bikers, and many others, as well as for "geocaching" games, where individuals use GPS coordinates to find "hidden treasures."
- Environmental
 - A water filtration system designed for the ISS, the Regenerative Environmental Control and Life Support System, has been repurposed to provide safe drinking water on Earth—the unit is currently providing fresh water to villages in Iraq
 - An environmentally friendly remediation solution developed to restore grounds at KSC affected by chemical contamination is now cleaning up areas around the United States that have been impacted by high concentrations of harmful chlorinated solvents, including dye and paint manufacturers, dry cleaners, chemical manufacturers, metal cleaning and degreasing facilities, leather-tanning facilities, pharmaceutical manufacturers, adhesive and aerosol manufacturers, among others.
- Security
 - A Mars Exploration Rover prototype robot has been further developed for use in Afghanistan and Iraq to help U.S. troops clear caves, bunkers, search buildings, cross mine fields, and deal with Improvised Explosive Devices (IEDs)
 - A technology originally developed at NASA's MSFC for enhancing video imaging is now being used for real-time video image enhancement, stabilization, and tracking. This imaging system was used in the 1996 Olympic bombing investigation, as well as many other video-based investigations.
- In this way, we have turned space technologies over to the private sector to benefit nearly all aspects of life on Earth. Space exploration requires us to visit new places which, in turn, causes us to look at our world and our technologies differently. In this way, the techniques we use to explore space allow us to improve existing Earth-based products and services as well as invent entirely new ones.

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**

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- NASA explores for answers that power our future, and we are powering inspiration that encourages future generations to explore.
- Inspiration is necessary because NASA needs a well-educated workforce to carry out missions of scientific discovery that improve life on Earth.
- The stakes are high, and we have to face some cold, hard facts:
 - Many U.S. scientists and engineers, and teachers of those subjects, will retire in the next 10 years.
 - Less than 6% of high school seniors plan to pursue engineering degrees, down from 36% a decade ago.
 - China produces six times more engineers than the U.S., and the European Union produces three times as many as the U.S.
- In addition, the global marketplace is becoming increasingly competitive and technology driven.
- To shape tomorrow's workforce, America must:
 - Motivate students and
 - Provide teachers with information that prepares students for high-tech jobs.
- NASA continues to develop educational tools and experiences that inspire, educate, and motivate educators and students alike
- 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 almost 60% 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 CDR scheduled for 2010
 - Ares I-X test flight is on schedule for 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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- There has never been a more exciting time to be a part of this mission, as we are completing the ISS and developing the capability to move beyond low Earth orbit. People have lived aboard the ISS continually since 2000.
- We are starting to design and build new vehicles, using extensive lessons learned to minimize cost, technical, and schedule risks.
- Many of the lessons we must learn to further explore space safely and be productive, we will learn by first reaching for the Moon. We are in the process of taking those first steps now and are making great progress. We are on schedule to have the Ares I-X test flight in 2009
- This is a multi-decade project that will ensure America's access to and exploration of space for generations to come, yielding new knowledge and a wealth of technology benefits that will help improve the quality of life on Earth.

