

Facts about NASA's Exploration Architecture and New Spaceship

Vision for Space Exploration

- President George W. Bush set a bold Vision for Space Exploration on January 14, 2004, that instructed NASA to return the space shuttle to flight, complete the International Space Station, return to the moon, and continue on to Mars.
- Extending a human presence across the solar system and beyond will require a sustained and affordable human and robotic program using innovative technologies, knowledge and infrastructures. NASA will promote international and commercial involvement whenever practical.
- Returning to the moon provides opportunities to develop and mature technologies needed for long-term survival on other worlds. It builds confidence so we can venture farther from Earth and stay for longer periods.
- Sustained moon visits also give us the opportunity to conduct fundamental science in astrobiology, geology, exobiology, astronomy and physics.
- NASA will follow a safe, accelerated, affordable, yet sustainable approach to achieving its Vision goals. This could shorten the gap in U.S. human space flight once the space shuttle is retired in 2010, and ensure the U.S. can continue to service the International Space Station.

Next Generation Spacecraft

- NASA's next generation spacecraft will use an improved, blunt-body capsule, much like the shape of the Apollo spacecraft only larger. With an outside diameter of approximately 5.5 meters, the spacecraft will have more than three times the volume of the Apollo capsules. This design will shorten development time, reduce reentry loads, increase landing stability, and permit safe travel for up to six crewmembers.
- The new spacecraft can be configured as a crew or cargo module. The crew module will carry four crewmembers during lunar missions and up to six crewmembers for Mars missions.
- This spacecraft design offers significant advancements over the Apollo capsule. Besides being safer and more reliable, it doubles the number of crew to the lunar surface, permits landing anywhere on the moon, and fully supports a permanent human presence while preparing for future Mars missions.
- The spacecraft will have a total mass of 25 metric tons, be able to dock with the International Space Station and other exploration elements, use a liquid oxygen /

liquid methane service module propulsion system (yet to be developed), and return to dry land with a water landing as backup.

Launch System

- After extensive study of all viable options, NASA chose the shuttle-derived option for its launch system because of its superior safety, cost and schedule availability. Specifically, the space shuttle's main engines and solid propellant rocket boosters are reliable, human-rated, and best able to fit the planned architecture. The industrial base to support this option is already in place that will significantly lower development costs and support a workforce that will transition when we retire the shuttle in 2010.
- NASA chose two primary launch vehicles. The crew launch vehicle is a single four-segment shuttle solid propellant rocket booster with a liquid oxygen / liquid hydrogen upper stage supporting one shuttle main engine. This configuration can lift 25 metric tons. This capacity can be increased by an additional 7 metric tons if a fifth segment is added to the booster.
- The crew launch vehicle is 10 times safer than the space shuttle, primarily due to its in-line design and launch abort system. Should conditions warrant, the spacecraft and crew can separate from the upper stage of the launch vehicle and make a safe landing on land or in water.
- The lunar heavy cargo launch vehicle will consist of five shuttle main engines, and two, five-segment shuttle solid propellant rocket boosters. This combination yields a lift capability of 106 metric tons to low Earth orbit, and 125 metric tons if using an Earth departure stage. Although primarily designed to carry cargo, this system can be human-rated to carry crew into orbit.
- NASA has the capability to land 21 metric tons on the lunar surface with dedicated cargo missions.

- The Earth departure stage uses a liquid oxygen / liquid hydrogen propulsion system similar to the shuttle external tank that supports two J-2S engines. The Earth departure stage ignites suborbitally and delivers the lander to low Earth orbit. After the crew spacecraft docks with this system, the Earth departure stage performs a trans-lunar injection burn, which starts the vehicle's journey to the moon. When the burn is completed, the Earth departure stage is discarded. This is what will get us to the moon.

Lunar Mission

- NASA will follow a logical and deliberate path on its journey to the moon. Returning to the moon will allow us to develop and mature the technologies needed for further exploration to Mars and beyond. A sustained presence will demonstrate we can survive on another world by living off the land and will build confidence that we can venture still farther and stay for longer periods. Returning to the moon also will let us conduct fundamental science in astrobiology, geology, exobiology, astronomy and physics.
- Prior to returning to the moon, we will send robotic missions to further study, map and learn about the lunar surface. These early missions (between 2008 and 2011) will help select landing sites and determine whether in-situ resources are available (oxygen, hydrogen, metals, etc.).
- Robotic missions will provide the critical data necessary to ensure a safe and successful human mission back to the moon. Engineers will develop robotic hardware that can be reused once humans arrive.
- Production of the lunar lander, heavy launch vehicle, and Earth departure stage will begin in 2011 with a human lunar flight scheduled for 2018. These first lunar missions will be short "seven-day" sorties.
- Starting in 2013, NASA will begin production of the equipment required to sustain long-term lunar visits.
- Once launched into low Earth orbit, a four-member crew will rendezvous with the lunar lander before leaving for the moon. Once in lunar orbit, all four crewmembers will transfer to the lunar lander for travel to the moon's surface. The crew spacecraft will stay in orbit in an unmanned configuration.
- The lander will use a liquid oxygen / liquid hydrogen propulsion system for descent, and a liquid oxygen / liquid methane propulsion system for ascent.
- The crew will use an airlock for surface activities. Crews will conduct scientific investigations to understand planetary processes as well as the integrated effects of gravity and radiation on the human body.

- NASA will establish a lunar outpost, one mission at a time. Each mission will enable longer stays.
- Apollo was restricted to landing sites along the moon's equator. Our new systems let us land anywhere on the moon's surface. Scientists currently consider the lunar south pole to be a good landing site because researchers believe that area has elevated quantities of hydrogen and possibly water ice that can be used in a habitat environment.