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To extend life to there,
To find life beyond.

NASA Projects

University Forum
October 21, 2016

NASA - Jet Propulsion Laboratory,
California Institute of Technology

Tony Gutierrez
P: (818) 393 7387
C: (818) 648-0670
Tony.Gutierrez@jpl.nasa.gov

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Agenda

NASA's next giant leap for space exploration
&
Deep Space "MARS" Exploration

Space Launch System – NASA's new most powerful rocket

Mars 2020 Rover purpose and development

Dawn mission to the asteroid belt – Vesta and Ceres

OSIRIS-REx – Sample return mission to asteroid Bennu

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Last Shuttle Ferry flight
End of a 30-year Era

VIDEO – Last Shuttle flight

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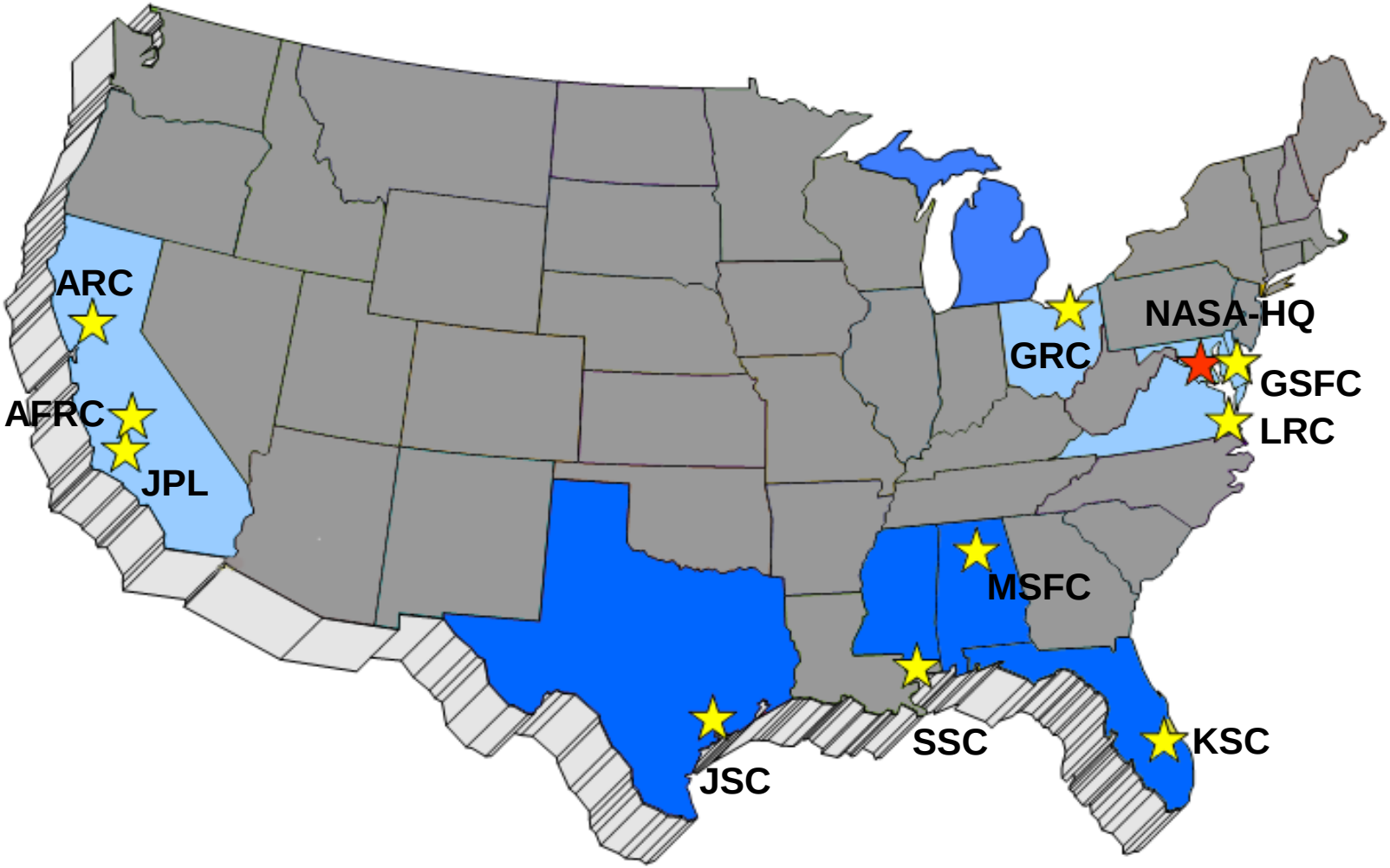
NASA FACILITIES and HQ



Transition to a new program

Upon retirement of the space shuttle on July, 2011 after 30 years of service, NASA embarked on an ambitious plan for Deep space exploration.

The development of the Space Launch System began in 2012.

Conducting the necessary experiments to better understand the space environment.

Collect data on how these new technologies behave in the harsh environment of space travel.

Formulate experiments to understand how the human body reacts when being in space for long periods of time.

How can astronauts be protected from the high exposure to space radiation and other environmental risks.

Space Launch System
"The new big Rocket"

NASA continues to work diligently on its journey to the red planet.

Developing the right infrastructure and ground support operations to be able to launch its new powerful rocket.

Carrying out all necessary testing that will support completion of the SLS vehicle and capsule.

From understanding the Mars environment to conducting essential research to ensure a successful man spaceflight mission to Mars.

The effort ranges from better understanding the potential risks of space to materials needed to protect the astronauts.

Other testing includes: Deployable habitats that can be sent in advance for when the astronauts get there.

SLS Technology

NASA made the mindful decision to return to the Apollo type rocket system which has proven technologies.

The design and development Space Launch System (SLS) includes legacy hardware from the Constellation program.

Also the Orion capsule has capacity to carry up to 6 astronauts instead of three as in the Apollo capsule.

In 2015, the SLS completed its Critical Design Review

There will be initially three versions of the SLS:

Block 1 - 70 Metric Ton with capability to lift [77 Tons] [Man Rated]
Block 1B - 115 Metric Ton with capability to lift [115 Tons] [Man Rated]
Block 2 – 130 Metric Ton with capability to lift [143 Tons] [Cargo Rated]

Design Certification will take place in 2017 and Flight Readiness Review in 2018

Its first test flight EF-1 [November, 2018] to qualify its technologies including structural stress to communications/telemetry and more...

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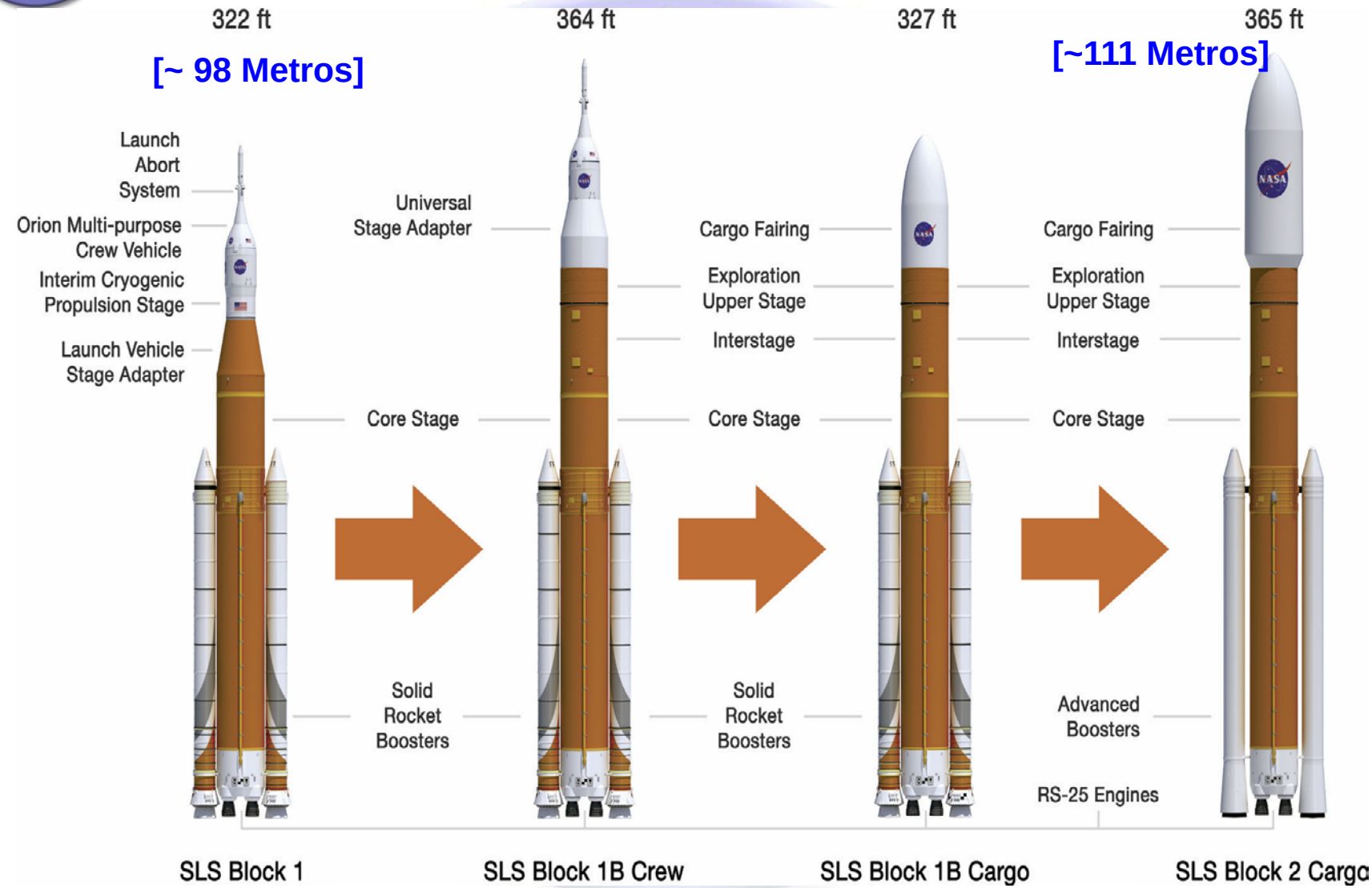
SLS Configurations



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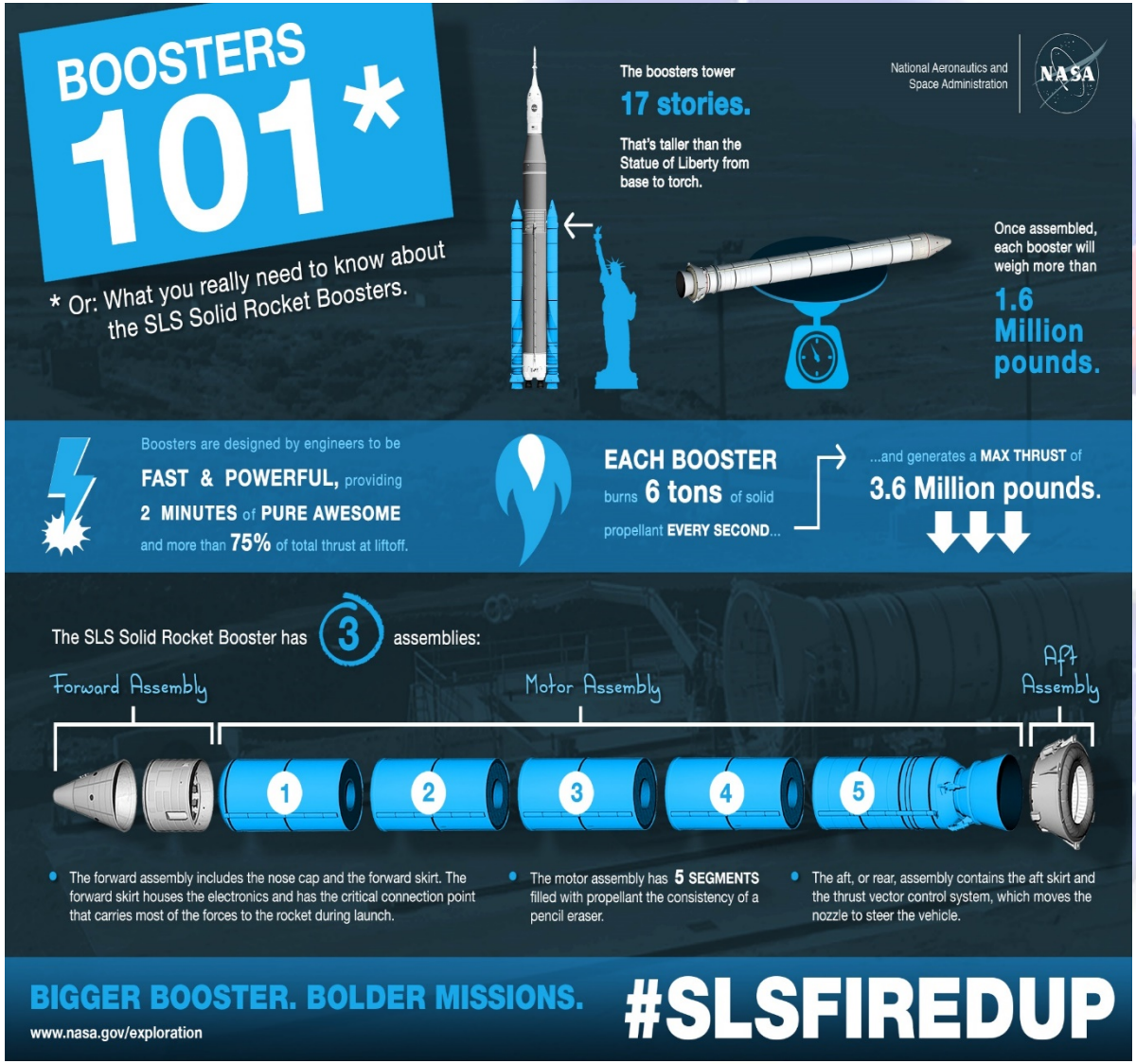
Booster Facts



Boosters:

[~50 Metros]

17 stories high

Has 5 segments

[~726,000 Kg]

Weight is 1.6 Million pounds assembled

Burns 6 tons of propellant per sec.

[1.6 Mil. Kg]

Max. thrust of 3.6 Million pounds

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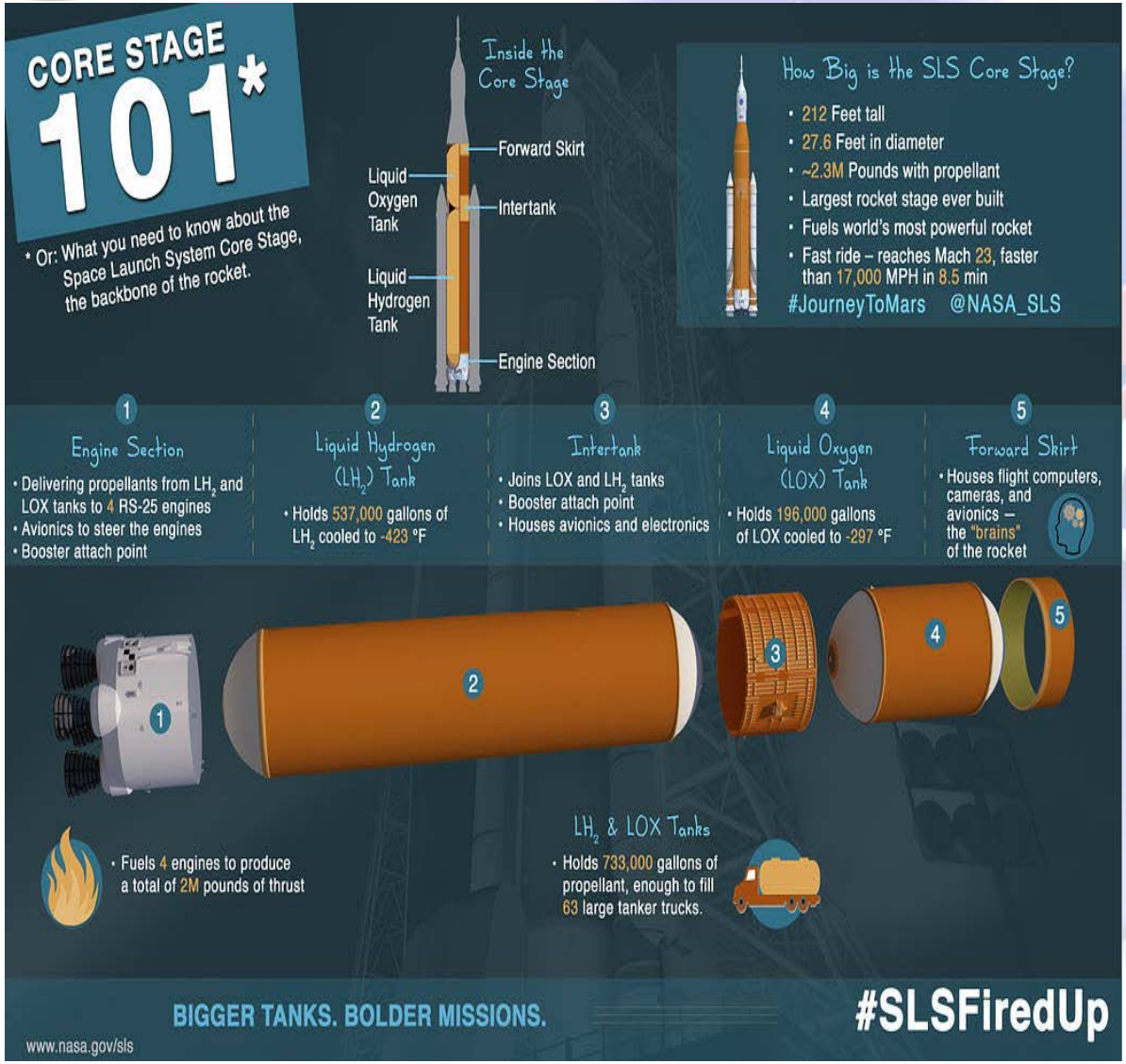
Core Stage Facts



Core Stage:

Height - 212 Ft. **[~64 Meters]**
Diameter – 27.6 Ft. **[~8.4 Meters]**

Largest rocket stage built.

Mach 23, 17,000 MPH in 8.5 minutes. **[~27,350 KPH]**

Fuel: Liquid Hydrogen and Oxigen

Direction

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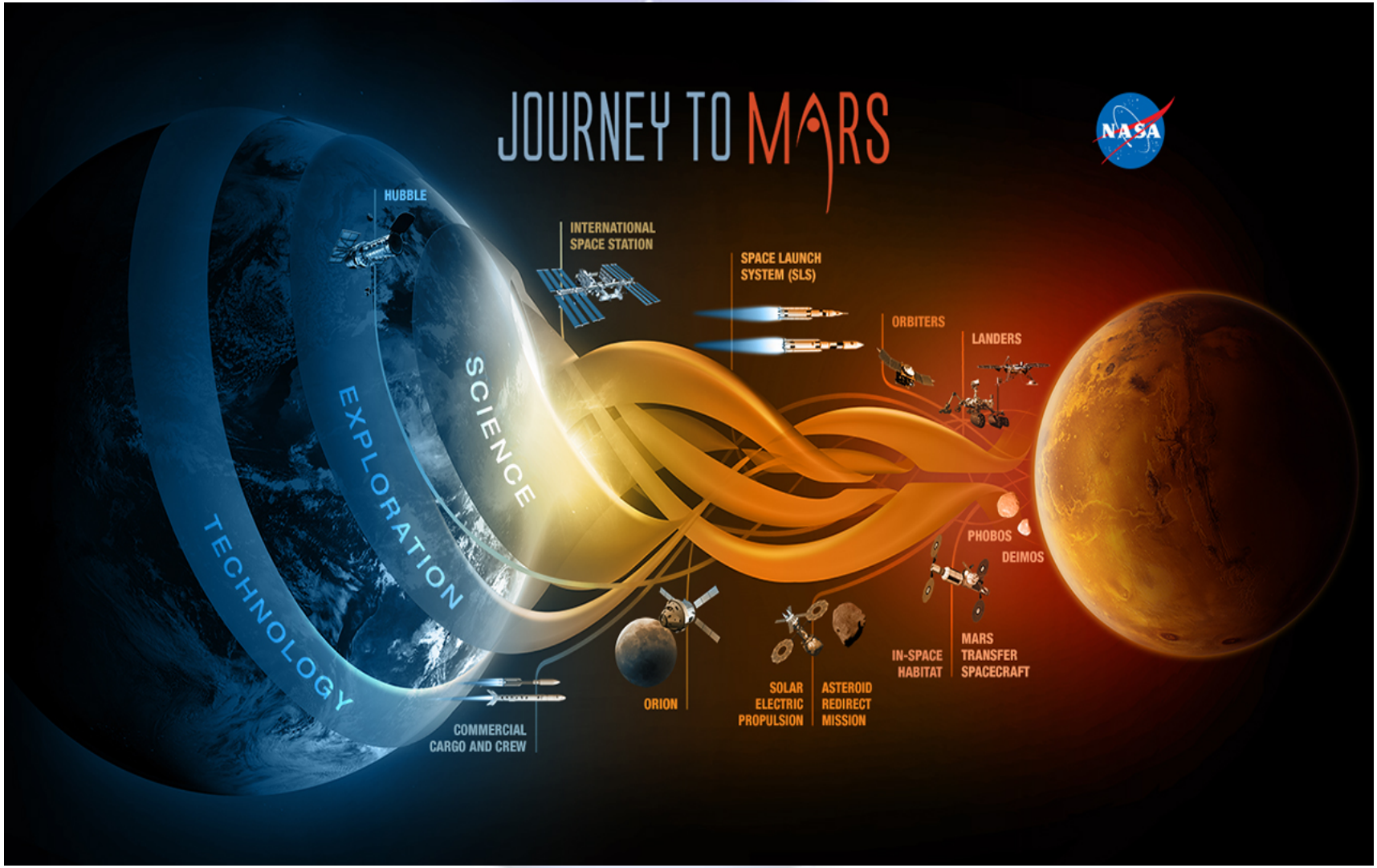

SLS Construction
Time Lapsed Video

SLS in Flight

SLS Capability

NASA is developing a first-ever robotic mission to visit a large near-Earth asteroid, collect a multi-ton boulder from its surface

ARRM – Proposed Asteriod Redirect Robotic Mission:

One of NASA's initiative is to capture an asteroid and place it in a stable lunar orbit.

The first SLS mission would be to travel to that asteroid, take samples and bring those back to earth for examination in the 2020s.

This would be a milestone for the SLS to further certified all systems and learn from that mission.

Also, this precursor mission's intent is to gather experience and lessons learned and implement them for the manned flight to Mars.

The follow on mission will be a rendezvous around Mars and return to earth.

This Asteroid Redirect Robotic Mission (ARRM) is part of NASA's plan to advance the new technologies toward a human mission to the Martian system in the 2030s.

ARRM Mission Video

Other Challenges

Space challenges include:

1. Protection from radiation – experiments being conducted to assess how astronauts can be protected for the journey to Mars.

2. Food and Water supply – Dried food and experiments on how to grow food in space experimented at the Space Station.

3. Sustainability on Mars – A two-year window, therefore must have capability to grow food on Mars.

4. Loss of Bone Density, Sight, Balance, Motor Skills, and Weakened immune System.

Research – One year stay on the Space Station for a twin astronaut.

5. Psychological factors:

Confined into a small space for 8 – 10 months
No human interaction besides the few astronauts
No exposure to earth air and nature

Current technology, travel time to Mars is approximately 9 – 10 months

Astronauts must be protected from two sources of radiation.

1. **Solar particles and occasional larger bursts from giant solar flares**

2. **From Galactic Cosmic Rays [GRCs - mostly protons] – coming from other stars and galaxies in the Milky Way travelling at nearly the speed of light [186,282 miles per second or 299,792 kilometers/second]**

Mars lacks an ozone layer, which on Earth shields us from lethal doses of solar ultraviolet radiation.

In the presence of ultraviolet radiation, superoxides break down organic molecules.

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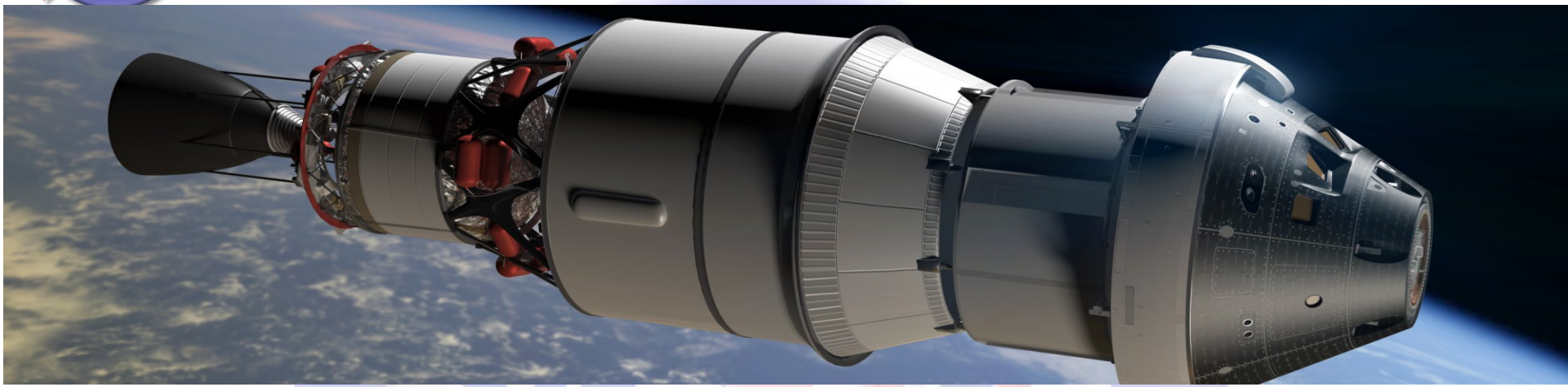
ORION Space Capsule



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Suited Astronauts test Orion

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Orion Egress Test

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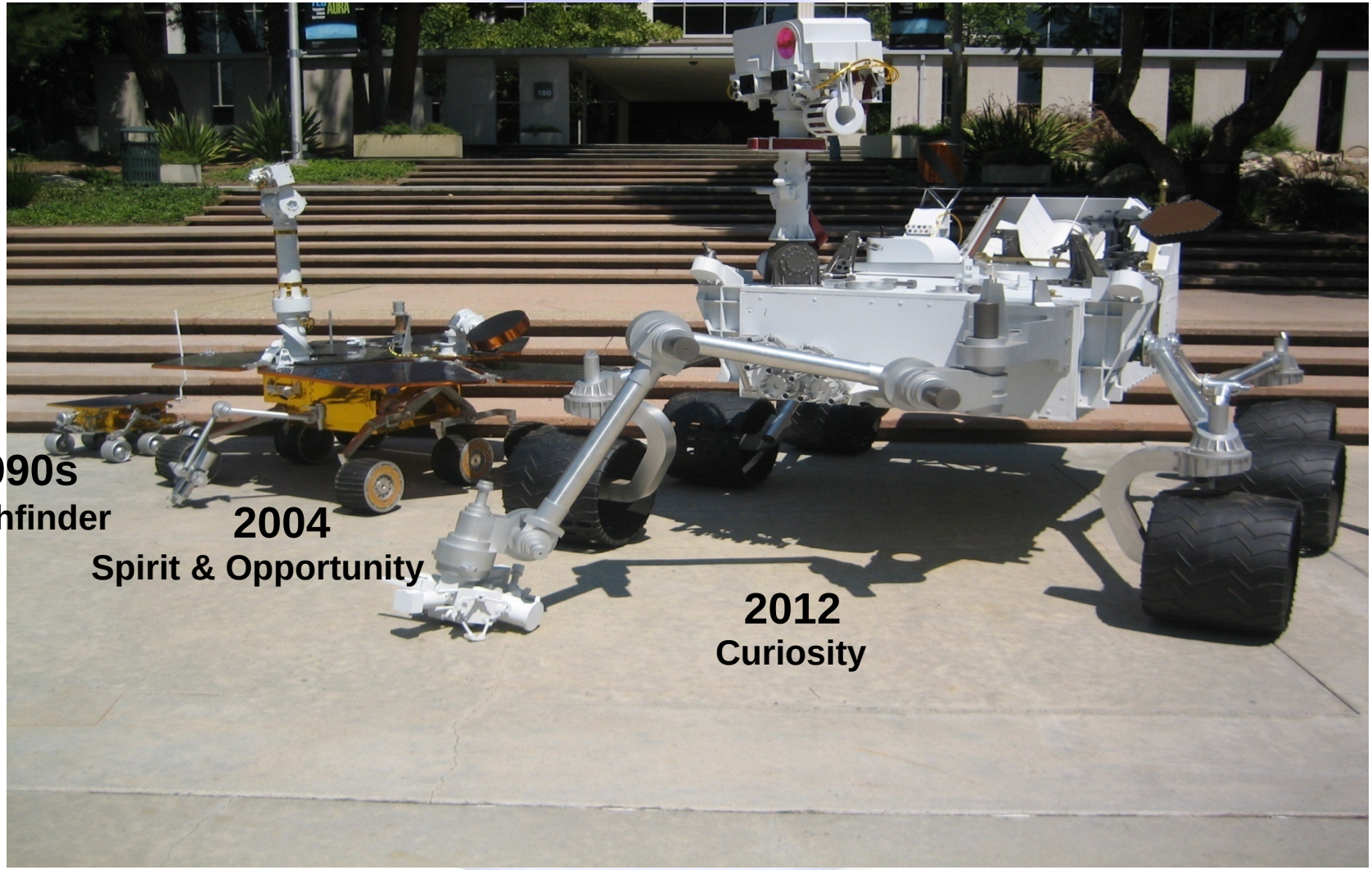
Mars Exploration – Rovers Legacy



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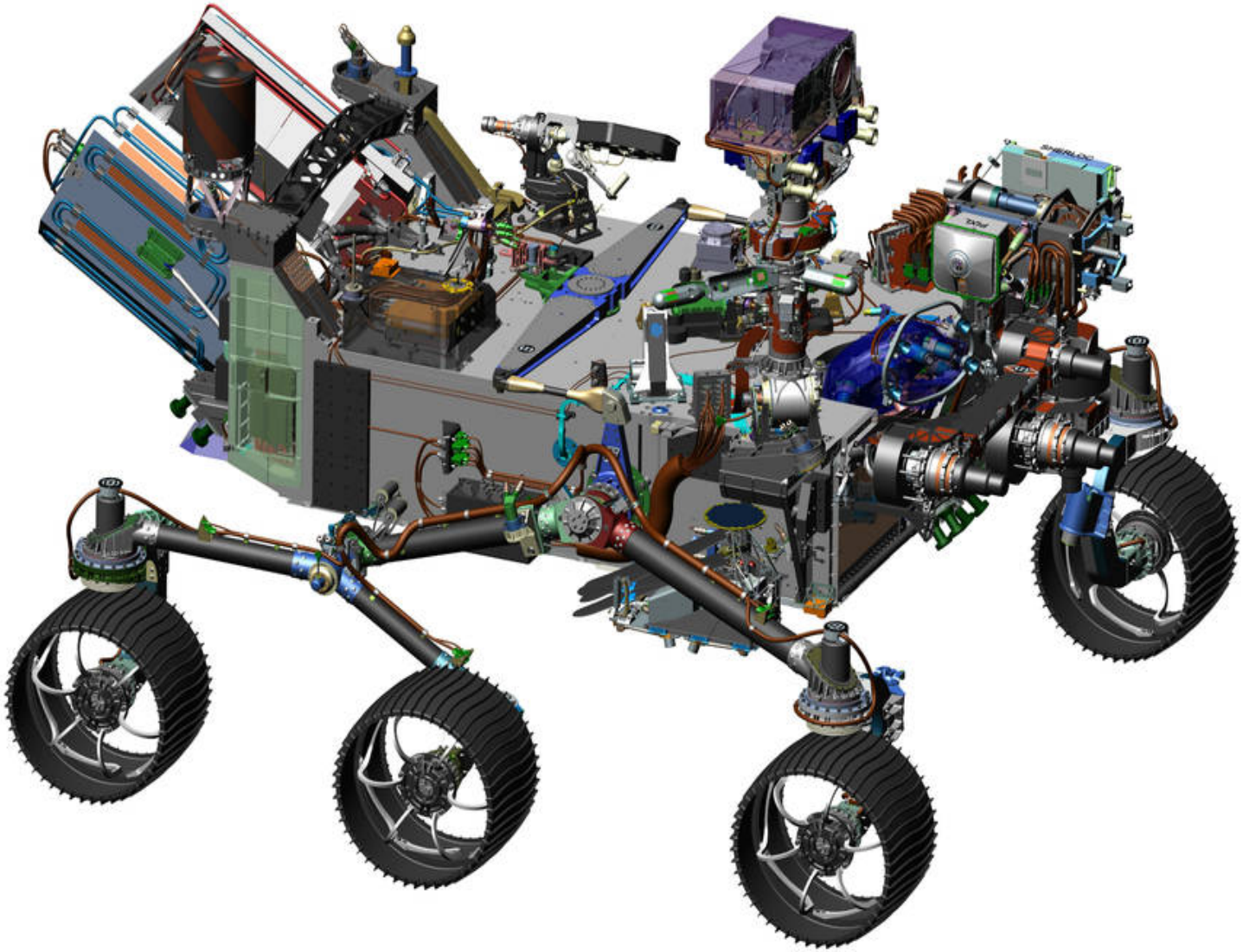
MARS 2020
Fourth Generation Rover



Mars Exploration Program

The latest - Mars 2020, very similar to the Curiosity Rover which landed on Mars on August 5, 2012.

Mars 2020 will have new technology to continue exploring and assess whether The Red Planet ever had the right bio-ingredients for life.

Mars 2020 Mission: Timeline:

Launch scheduled for July-August, 2020 from Cape Canaveral, Kennedy Space Center.

Expected to Land on Mars in February 2021 at a site to be determined.

Spend at least one Mars year (two Earth years) exploring the landing site region

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Seven Minutes of Terror
"Curiosity Rover"

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What's New – Latest Launched Missions

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Dawn Spacecraft

Launched on September 2007. and on June 30, NASA's Dawn spacecraft completes its primary mission.

The historic mission is the first to orbit two extraterrestrial solar system targets, and the first to orbit any object in the main asteroid belt, between Mars and Jupiter.

Dawn has traveled 3.5 billion miles (5.6 billion kilometers), and made 2,450 orbits around Vesta and Ceres. Dawn has returned about 69,000 images total

Dawn has revealed that Vesta is a dry body, Ceres to be 25 percent water ice by mass.

Intriguing features -- Vesta has a mountain whose twice that of Mount Everest, and Ceres has a crater with mysterious bright features

Dawn Images

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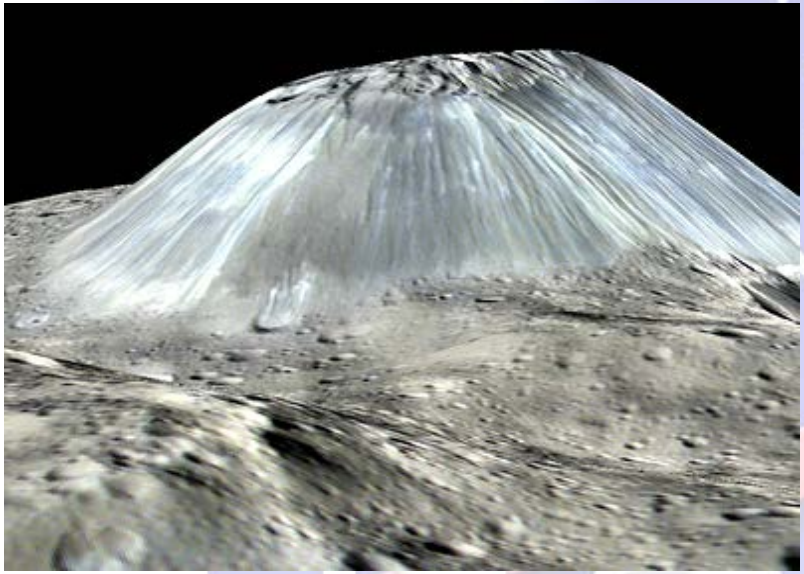
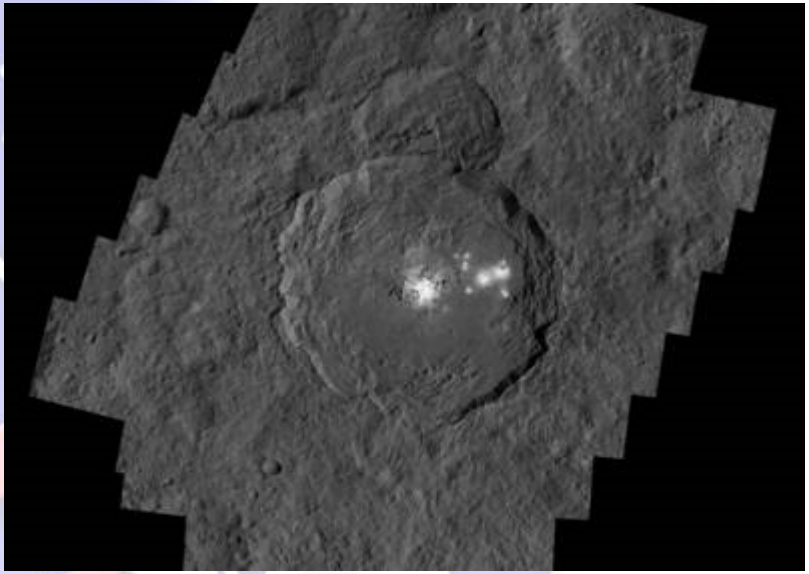
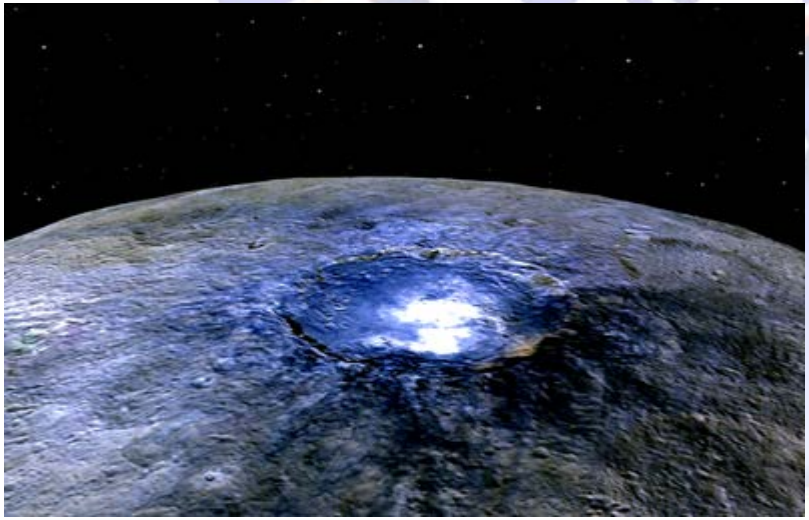
Vesta

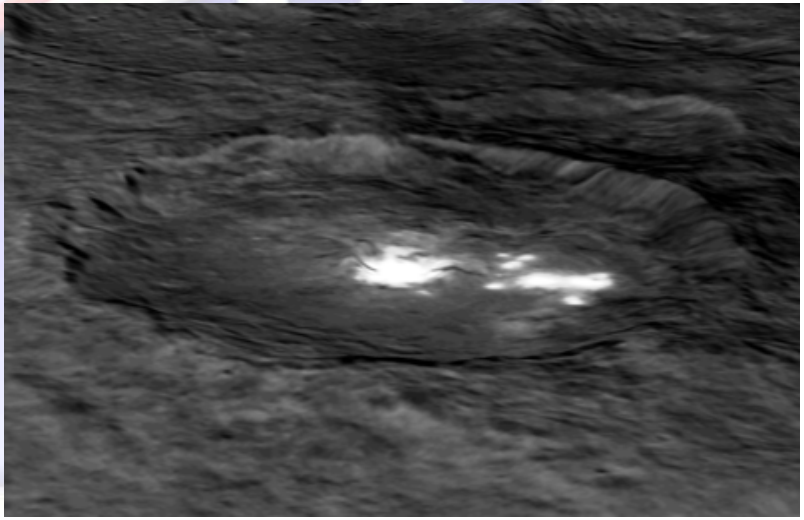




Ceres

Ceres





Ceres

Dawn – Video

Asteroid Sample Return Mission

OSIRIS-REx Asteroid Mission was launched September, 2016.

Explorer spacecraft will travel to a near-Earth asteroid, called Bennu (formerly 1999 RQ36).

Take at least a 2.1-ounce [59.5 grams] sample and bring it back to Earth for study.

As planned, the spacecraft will reach its asteroid in 2018 and return the sample to Earth in 2023.

Help scientists investigate how planets were formed and life began, as well as improve our understanding of asteroids.

Its instrument will map Bennu and establish the composition of the asteroid, including the distribution of elements, minerals and organic material.

Goddard Space Flight Center is managing this mission

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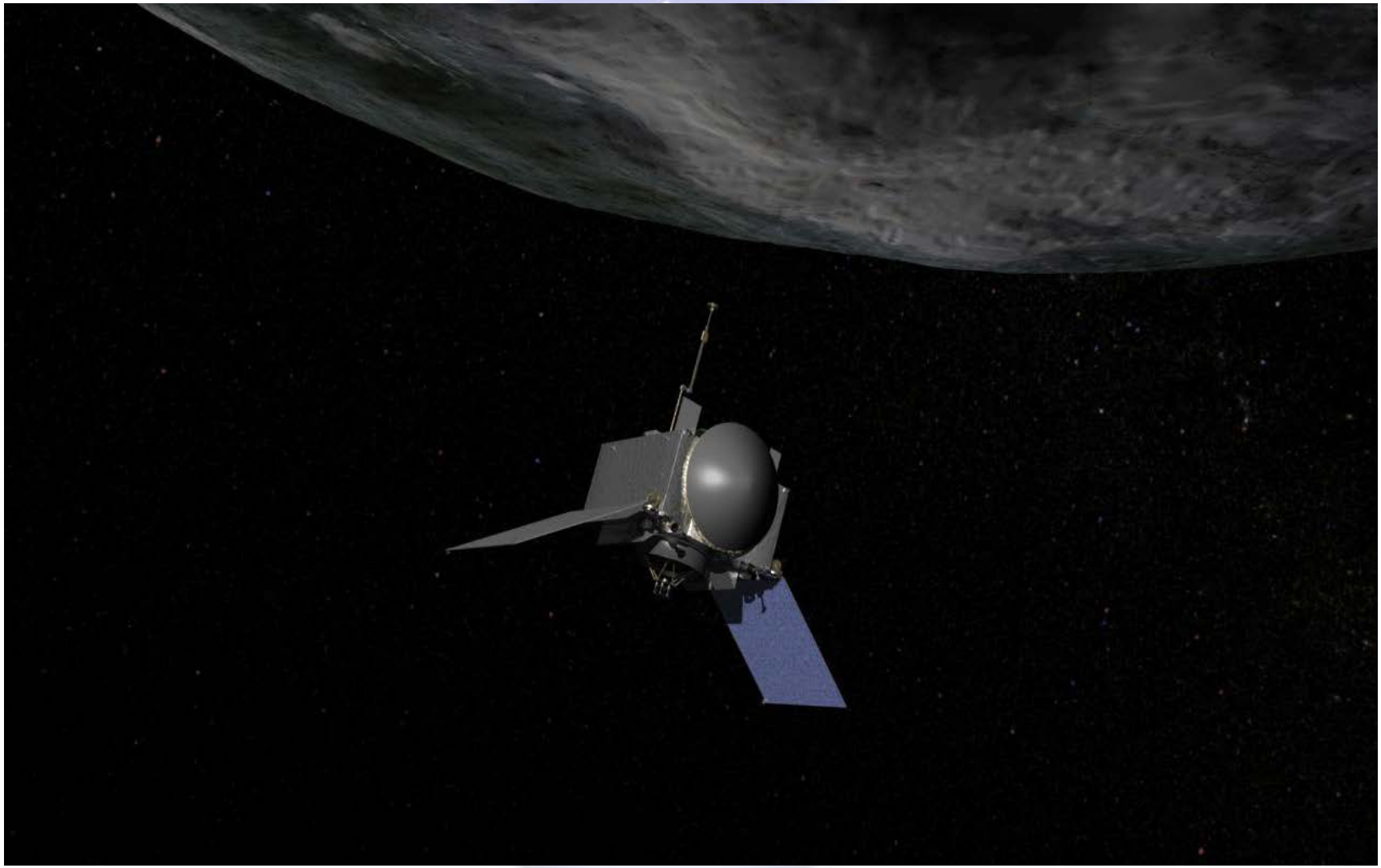
Osiris REx Spacecraft



Osiris-REx Video

"People who are truly effective have the humility to recognize their own perceptual limitations and to appreciate the rich resources available through interaction with the hearts and minds of other human beings."

Stephen R. Covey

In my own words….

"Set your goals higher than you can reach them, and press forward embracing bigger challenges, yet keeping personal integrity and respect for others"

Tony Gutierrez