



Marshall Space Flight Center

Launching the future of science and exploration



marshall



Marshall Space Flight Center

Marshall has the engineering expertise to ensure our nation can send humans beyond Earth and into deep space.

- Our unique capability is in large scale, complex space systems development with a core expertise in propulsion.
- We advance space technologies, spark economic development, expand our knowledge, and inspire a new generation of explorers.

Marshall Mission Areas



**Lifting from
Earth**

**Living and
Working
in Space**



**Understanding
Our World
and Beyond**





Marshall has the engineering expertise to ensure our nation can send humans beyond Earth and into deep space.

Lifting from Earth

America's Human Spaceflight Architecture

Commercial support for
ISS in low Earth orbit

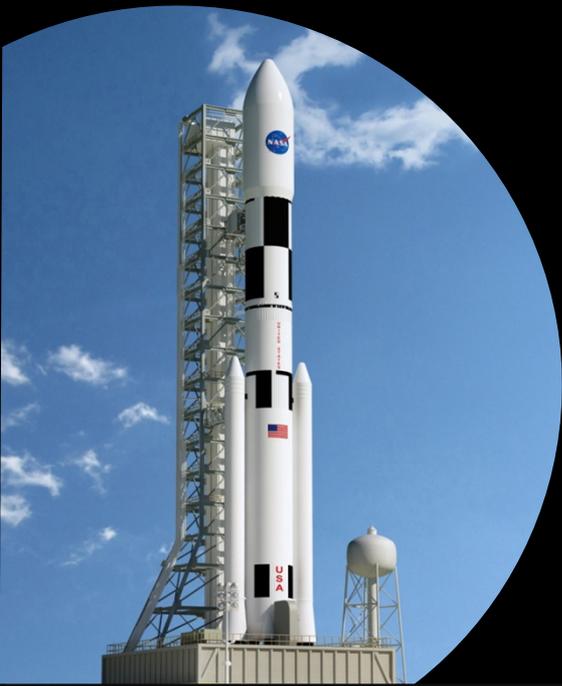


SLS for reaching new destinations
beyond low Earth orbit



*Ensuring our nation can send humans beyond
Earth and into deep space.*

Lifting from Earth



Space Launch System (SLS)

America's next rocket –
sustainable and affordable

Commercial Spaceflight

Partnering for success –
sharing facilities and expertise

Research for the Future

New fuels, new testing methods,
and advanced concepts



SLS – Block I
(70-ton)



J2-X Engine Pack
Testing



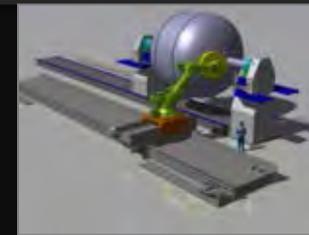
Supporting
Commercial
Spaceflight



Affordable Testing for
Nuclear Fuel
Prototypes



Collaborative
Engineering Design



In-space Cryogenic
Fuel Storage Concept

Marshall is leading our nation's propulsion capabilities.

Lifting from Earth

SLS – America's Heavy Lift Rocket

- Safe, affordable and sustainable
- Carries the Orion Multi-Purpose Crew Vehicle
- Supports national missions beyond Earth orbit
- Back-up for ISS transportation
- Initial lift capacity of 70 tonnes (t) evolving to 130 t
- Builds on Saturn, Shuttle and Ares experience



Solid Rocket
Motor Test



Friction Stir
Welding



Shell Buckling
Test



Upper Stage
J-2X Engine



J-2X Engine
Tests



Core Stage
RS-25 Engines

SLS is essential to the nation's space exploration goals.

Lifting from Earth



SLS – On-track for a 2017 first flight

- Key tenets: safety, affordability, and sustainability
- Progress being made on all elements of the vehicle
- Prime contractors on board, work being done across the country
- Completed System Requirements Review / System Definition Review, now working toward Preliminary Design Review in 2013
- Flight hardware being tested on EFT-1 in 2014
- Design Analysis Cycle (DAC) 2 configuration released

Supporting U.S. Leadership in Propulsion Systems

NIRPS

National Institute for
Rocket Propulsion Systems

Stewardship

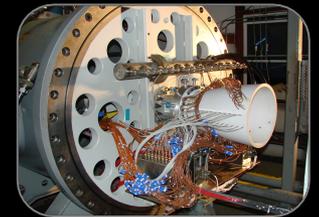
Formulate and recommend National Policy options and strategies that promote a healthy industrial base.

Technology

Identify technology needs and recommend technology insertions.

Solutions facilitator

Maintain relationships and awareness across the Government and industry to align available capacity with emerging demand.



NIRPS: An Enabler for America's Space Endeavors

Academia



Industry



U.S. Government



NASA



FAA



DOD

NIRPS

Fostering
a vibrant rocket propulsion community
that provides reliable and affordable propulsion systems
in support of the nation's defense, civil and commercial needs.

A composite image of space. In the foreground, the curved horizon of the Earth is visible, showing blue oceans and white clouds. Above the horizon, the Moon is shown in a dark, cratered phase. Further up, a small white satellite or space station is visible. To the right, a planet with a reddish-orange surface is partially visible. The background is a deep blue and purple nebula with wispy patterns of light.

Our unique capability is in large scale,
complex space systems development.

Living and Working in Space

Living and Working in Space

Supporting Life in Space

Supporting Scientific Research in Space



Lab Training Complex



Payload Operations
Center



ECLSS testing
at Marshall



Microgravity
Science Glovebox



U.S. Destiny Lab

From large space structures to life support systems and operations, Marshall supports crews in space.

Living and Working in Space

Supporting Life in Space

- International Space Station
 - Continual human presence since 2000
 - Completed in 2010
- Major U.S. nodes and modules
- Cleaning air and recycling water
- Environmental affects on people and materials



ISS Test Facility
at Marshall



Node 3
Tranquility



Delivery of the ISS
Cupola



Atmosphere Resource
Recovery and
Environmental
Monitoring



Multi-purpose
Logistics Module,
Leonardo



Environmental
Control & Life
Support System
(ECLSS)

Marshall develops systems for living and working on the ISS.

Living and Working in Space

Supporting Scientific Research in Space

- Manage science operations around the clock
- Window Observational Research Facility
- Microgravity Science Glovebox
- Materials Science Research Rack



**Payload Operations
Center at Marshall**



**WORF – Window
Observational
Research Facility**



**EXPRESS Racks for
Destiny Module**



**Materials Science
Research Racks**



**Microgravity
Science Glovebox**



Destiny Laboratory

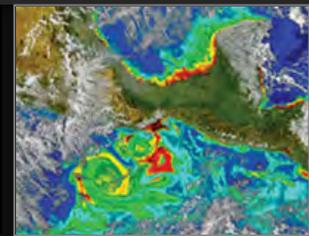
Marshall is the command post for science on the ISS.

A composite image of space featuring a nebula, the moon, a small satellite, and a planet in the distance.

We advance space technologies and expand our knowledge of the universe.

Understanding Our World and Beyond

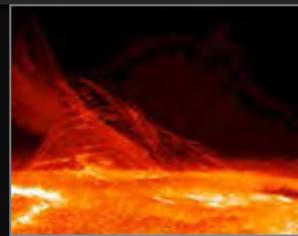
Understanding Our World and Beyond



**Weather & Climate
Monitoring**



SERVIR



**SUMI Solar
Capture**



**Discovery &
New Frontiers**



Chandra



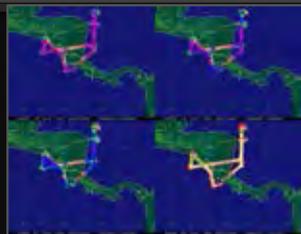
**James Webb
Space Telescope**

***Marshall is expanding knowledge
of our world and beyond.***

Observing Earth



- Understanding global climate system patterns
- Improving weather forecasts and storm warning times
- Predicting the intensity and dynamics of storms
- Providing and analyzing data for urban planning and natural resource and environmental management



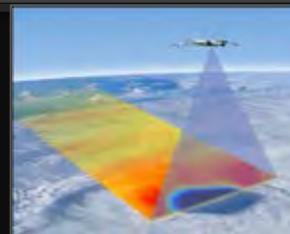
AMPR



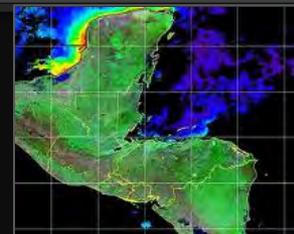
**Weather &
Climate
Monitoring**



PEOPLE - ACE



**Hurricane
Imaging
Radiometer**

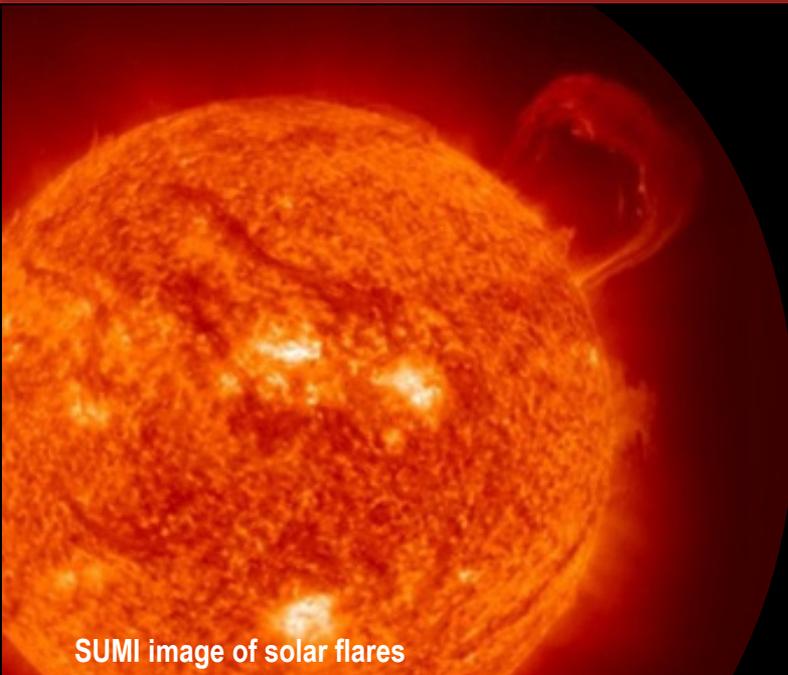


SERVIR



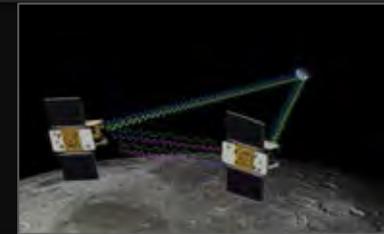
SPoRT

Studying Our Solar System



SUMI image of solar flares

- Managing missions through our solar system to learn more about asteroids, planets and their moons
- Developing robotic landers that can safely land on precise locations without human control
- Learning how the sun and space weather affect life on Earth
- Mapping the moon and measuring its gravitational field



*GRAIL, twin spacecraft mapping the moon



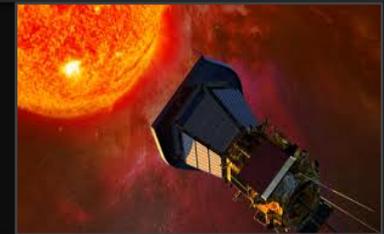
*Asteroid Vesta from Dawn spacecraft



Robotic Lander autonomous landing test



Preparing SUMI for flight



Solar Wind, Electrons, Alphas, and Protons (SWEAP)

Exploring the Universe Beyond



- Analyzing complex data from various space observation instruments
- Analyzing complex data from various space observation instruments
- Developing and testing optical systems for advanced deep-space telescopes applications
- Capturing visible and infrared light, gamma rays, and X-rays



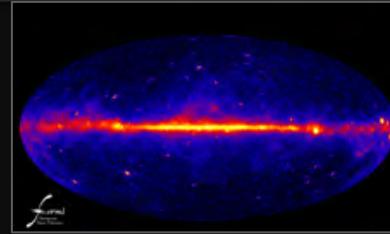
JWST mirror testing



JWST instrument testing



Cats Eye Nebula from Chandra X-ray Observatory



Fermi Gamma Ray Space Telescope map of the Gamma Ray sky



Omega Nebula from Hubble



Marshall supports NASA's mission.

Technology – Goals – Benefits – Education

Proving Technology Readiness

Advancing Space Technology Development

- Nuclear Cryogenic Propulsion Stage
- Atmosphere Resource Recovery and Environmental Monitoring (ARREM)
- Deep Space Habitat
- Radiation Protection
- In-Space Manufacturing
- Cryogenic Propellant Storage and Transfer
- Materials on ISS Experiments (MISSE)
- Robotic Lunar Lander Development (Mighty Eagle)
- Advanced Mirror Technology Development
- Edison Small Satellite
- Innovative Manufacturing
- In-Space Propulsion
- SWORDS
- Nuclear Systems
- Human-Robotic Systems
- Avionics Hardware
- Composite Cryogenic Propellant Tank
- Synthetic Biology

Demonstrating Feasibility of New Technologies

- Technology Demonstration Missions – Level II Program Office
- Centennial Challenges Program –Level II Program Office



Cryo Propellant Storage



MISSE



Robotic Lander



Green Flight



Space Tether



Composite Cryotank

The National Aeronautics and Space Administration



Science



Space
Technology



Human Exploration
and Operations



Aeronautics
Research

Marshall supports three of the NASA Mission Areas.

NASA and Marshall Strategic Goals

NASA Agency

Extend and sustain human activities across the solar system.

Expand scientific understanding of the Earth and the universe in which we live.

Create innovative new space technologies for our exploration, science, and economic future.

Advance aeronautics research for societal benefit.

Enable program and institutional capabilities to conduct NASA's aeronautics and space activities.

Share NASA with the public, educators, and students to provide opportunities to participate in our mission, foster innovation, and contribute to a strong economy.

Marshall Space Flight Center

Develop and operate integrated vehicles and systems to enable human space activities.

Develop, integrate, and operate instruments and conduct research to expand knowledge of the universe.

Develop, test, and mature new space technologies to enable NASA missions and benefit the Nation.

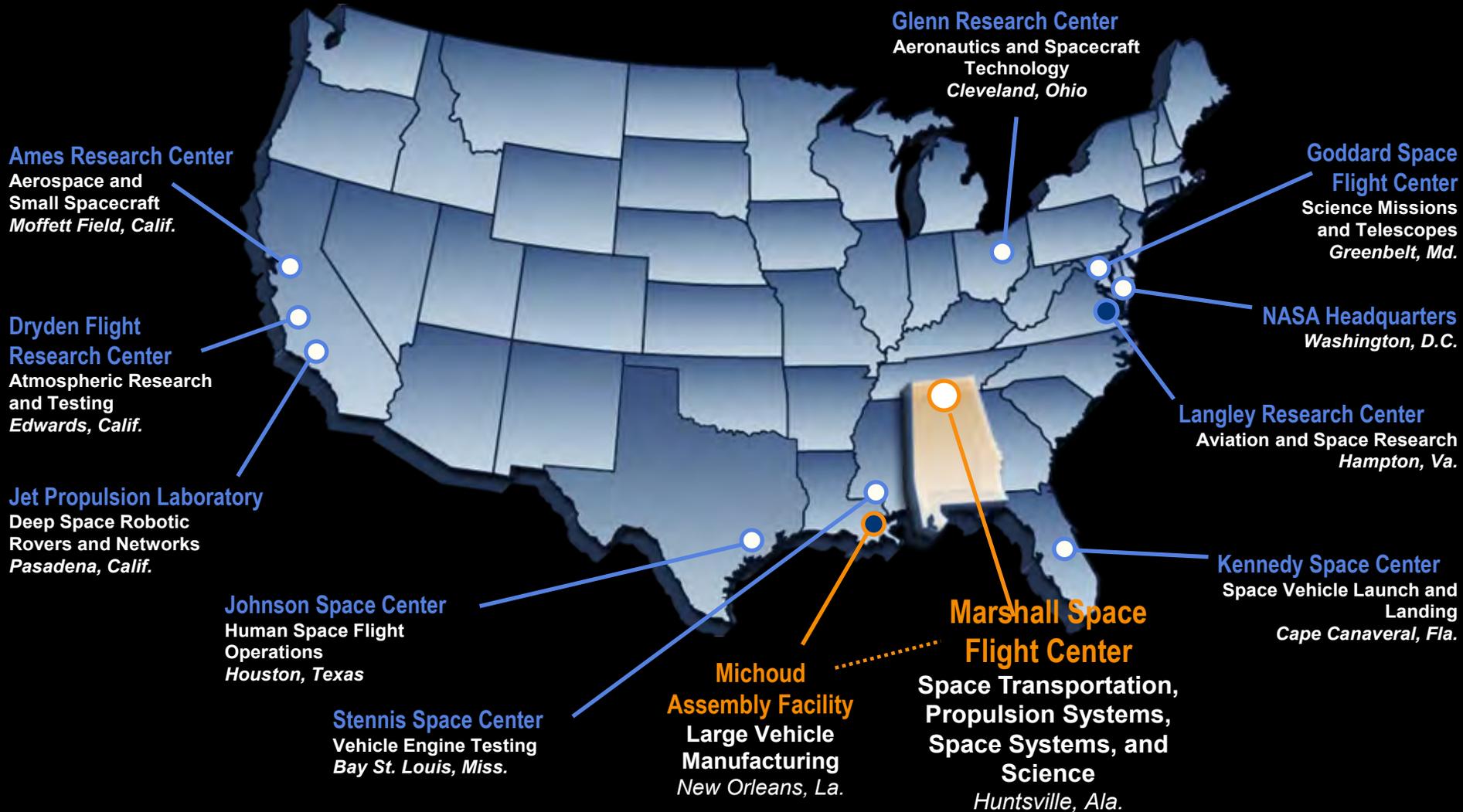
Marshall does not programmatically support aeronautics.

Provide and manage program, project, and institutional capabilities to conduct NASA's and Marshall's space activities.

Share NASA and Marshall with the public, educators, and students to foster communication, participation, and innovation to benefit the interests of the Nation.

Marshall's work aligns with five of the six agency strategic goals.

NASA Around the Country



Supporting NASA's mission with unique engineering expertise.

Benefitting Life on Earth - **Technology Spinoffs**



High-pressure fire
hose nozzles

Technologies developed
at Marshall touch our lives
in many ways.



Weather & Climate
Monitoring



Nextel™ Flame
Stopping Dot
Paper



Kevlar™ Body
Armor



Improving Vision
Screening



Healing
Treatments



Water Filtration
Systems

Science and exploration improves our lives and our planet.

Science, Technology, Engineering and Math (STEM)



Marshall reaches out to all ages to encourage STEM educations and careers.



Outreach Activities



Observe the Moon Night



Student Launch Projects



Moonbuggy Race



Co-op and Intern Programs



Marshall is inspiring a new generation of explorers.

NASA Centers' Regions for Public Outreach



NASA Headquarters



Ames Research Center



Dryden Flight Research Center



Glenn Research Center



Goddard Space Flight Center



Jet Propulsion Laboratory



Johnson Space Center



Kennedy Space Center



Langley Research Center



Stennis Space Center



Marshall Space Flight Center



Michoud Assembly Facility



A composite image of space. The bottom portion shows the curved horizon of Earth with blue oceans and grey landmasses. Above it, the Moon is visible in a dark phase. Further up, a small white satellite or space station is seen. In the upper right, the reddish-orange surface of Mars is visible. The background is a deep blue and purple nebula with scattered stars.

Marshall in the Community

Marshall Profile

Marshall Profile



\$2.3B expenditures nationally (FY2011)
\$1.2B in Alabama



Nearly 6,000 employees
(FY12 2,490 civil service)



3rd largest employer
in the Huntsville – Madison County area

26 core capabilities and more than 125 unique and specialized facilities and labs



Part of a technological community

Redstone Arsenal – home to 22 primary federal/international organizations

Cummings Research Park – 2nd largest in U.S. and 4th largest in the world

Huntsville's concentration of high-tech workers is 2nd in the nation

Marshall impacts the community.

Redstone Arsenal Major Organization Overview



Marshall's Economic Impact in Alabama

Research Grants:

\$30,000,000



Jobs:

6,255



2,484
civil service

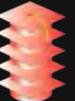
3,771
indirect

Education Levels



Huntsville: one of
the Top 10 Smartest
Cities in the World
- Forbes (12/09)

28%



U.S.

22%



AL

38%



HSV

91%



MSFC

PhD
Masters
BS/BA

Marshall's
Economic Impact
in Alabama (FY2011)
\$2,500,000,000

Earnings:

\$526,000,000



\$260m
civil service

\$208m
indirect

Statewide Contracts:

\$817,000,000



26% small
business

Small Business Innovative Research:

\$37,000,000



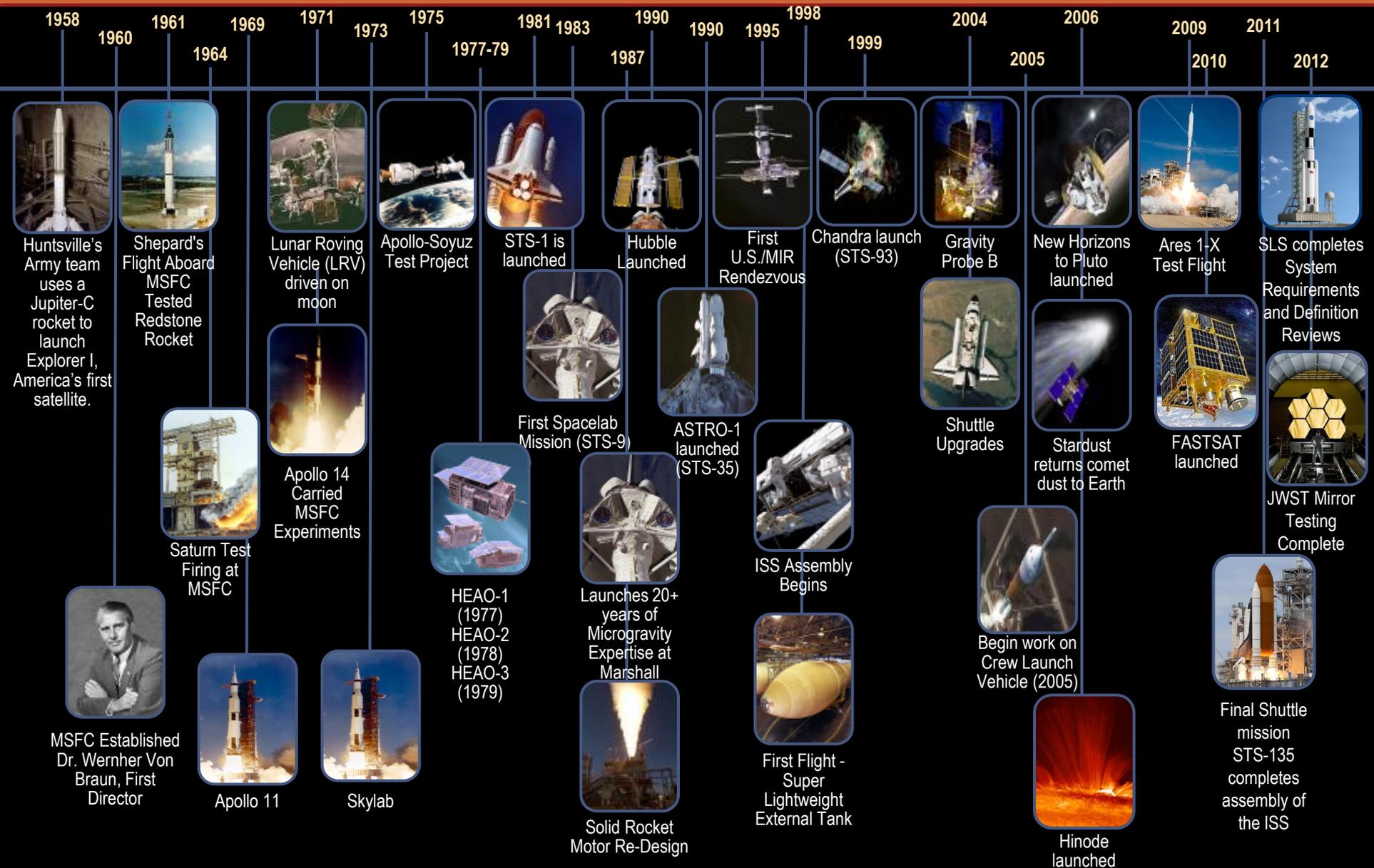
Giving Back:

\$730,000

(CFC)



Marshall Space Flight Center History



Visiting Marshall Space Flight Center

The U.S. Space & Rocket Center

- Home of Space Camp and Aviation Challenge
- Davidson Center for Space Exploration
- Spacedome Theater
- Rocket Park
- NASA's Educator Resource Center
- Interactive exhibits
- Historic artifacts

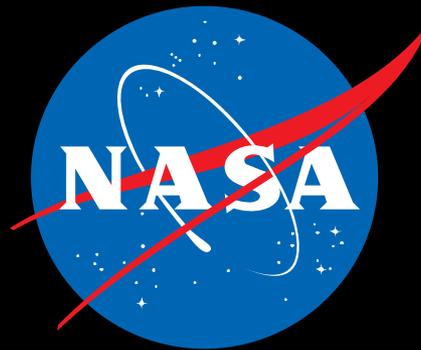


Marshall's Visitor Information Center is the U.S. Space & Rocket Center.

A composite image of the solar system. In the top left, a bright yellow Sun glows. To its right, the Earth is shown with the International Space Station orbiting it. Further right is the Moon. In the top right, Mars is depicted with a cratered surface and a small moon. The bottom half of the image is filled with numerous brown, rocky asteroids of various sizes floating in space.

*Somewhere, something incredible
is waiting to be known.*

— Carl Sagan



www.nasa.gov/marshall