



# NASA Exploration and Innovation Lead to New Discoveries

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**NASA Founded 1958**

On July 29, President Eisenhower signed into law the National Aeronautics and Space Act, thus creating the Space Agency.

**X-15 1959-1968**

This joint program by NASA, the U.S. Air Force, the U.S. Navy, and North American Aviation (now part of Boeing) provided data on hypersonic flight, aerodynamic heating, reaction controls for flight above the atmosphere, and piloting techniques for atmospheric reentry.

**Weather Satellites 1960-Present**

NASA launched the first Television Infrared Observation Satellite (TIROS) on April 1, 1960. The TIROS program evolved into the Nation's weather satellite system. NASA built and launched polar-orbiting weather satellites for NOAA through 2009 and continues to do so for geostationary satellites.

**Gemini 1962-1966**

The Gemini missions paved the way to the Moon and resulted in a variety of benefits. As a result of these missions:

- Miniature signal conditioners ease data exchange across health care organizations.
- Radiant barrier materials protect against temperature extremes.
- Anti-glare coatings for cathode ray tube screens minimize brightness, enhance contrast, and improve readability.
- Monitors for operating rooms analyze anesthetic gasses and measure patient oxygen, carbon dioxide, and nitrogen concentrations.
- Oil well and pipeline technologies facilitate operation of the Alaskan pipeline.
- Controlled explosives cut emergency exits in vehicles and demolish unsafe buildings and bridges.

**Mercury 1959-1963**

The six Mercury missions placed the first Americans in orbit and brought some of the first public benefits of the Space Program, including plasma heating for hydrocarbon decomposition and toxic, medical, asbestos, chemical, and radioactive waste disposal.

**Lifting Bodies 1962-1975**

Five heavyweight lifting-body designs provided an excellent starting point for designers of future vehicles, including the space shuttle.

**Apollo 1961-1975**

The missions that took humans to the Moon resulted in many benefits on Earth. Because of them:

- Cool suits alleviate dangers from high-heat environments and medical conditions.
- Kidney dialysis machines remove toxic waste from used dialysis fluid.
- A machine aids physical therapy and athletic development.
- A stress-free "blow molding" process manufactures athletic shoes.
- Communities benefit from water purification technology.
- Manufacturers preserve food through freeze-drying.
- Sensors detect hazardous gasses.

**Landsat 1-7 1966-Present**

For 34 years, the Landsat series of satellite missions jointly managed by NASA and the U.S. Geological Survey has collected information about Earth from space. Landsat satellites have taken specialized digital photographs of Earth's continents and surrounding coastal regions, enabling people to study many aspects of our planet and evaluate the dynamic changes caused by natural processes and human practices. This unparalleled data archive gives scientists the ability to assess changes in Earth's landscape and atmosphere.

**Skylab 1973-1979**

America's first space station and orbital science and engineering laboratory provided an unprecedented platform for experimentation and returned myriad benefits:

- Hand-held ultrasonic systems detect indications of bearing failure.
- Monitoring systems evaluate particulate matter in gas streams.
- Computerized solar water heaters save energy.
- Cryogenic liquid methane tanks store aircraft fuel.
- Emergency and night lighting systems save energy.
- Solar screens cut 70 to 80 percent of heat and glare.
- New wire-and-rod grounding systems prevent corrosion.
- Negative pressure techniques relieve respiratory distress in infants.

**F-8C Digital Fly-By-Wire Control System 1972-1985**

Now widely used by commercial airliners, the digital fly-by-wire control system improved maneuver control, ride, and combat survivability for military aircraft.

**Voyager 1977-Present**

30 years after launch, Voyager 1 and 2 are entering interstellar space. Both spacecraft still send information through the Deep Space Network, and have brought other benefits:

- AIDS research and e-commerce utilize software to identify data deviations.
- Astronomers and space enthusiasts employ software offering views recorded by spacecraft.

**Space Shuttle 1969-Present**

The Space Shuttle Program alone has generated more than 100 technology spinoffs. As a result of shuttle research:

- Miniaturized heart pumps save lives.
- Thermal protection system materials protect racecar drivers.
- Bioreactors help chemists design new therapeutic drugs and antibodies.
- Compact laboratory instruments allow faster blood analysis.
- Sensitive hand-held infrared cameras scan for forest fires.
- Rocket fuel helps destroy land mines.
- Light-emitting diodes treat cancerous tumors.
- Prosthetic limbs are lighter and stronger.
- An extrication tool removes accident victims from wrecked vehicles.
- Municipalities track and reassign emergency and public works vehicles.
- Law enforcement agencies can improve the resolution of crime scene video.

**NASA/FAA Research into Efficient Airspace Operations 1994-2001**

The Terminal Area Productivity (TAP) Program sought to achieve clear-weather capacity, safely and affordably, in instrument-weather conditions. Benefits include:

- Mathematically modeled wake vortices to determine safe aircraft separation standards.
- A new computer system to assist flight controllers, called the Aircraft Vortex Spacing System.
- A three-dimensional auditory display system for ground operations, including a computer-generated voice that provides verbal warnings of impending collisions with other aircraft or vehicles.

**Winglets 1979-1981**

Winglets applied to the tips of the main wings on KC-135 aircraft improved vehicle aerodynamics and fuel efficiency and are now universally accepted.

**X-29 Flight Research 1981-1990**

X-29 flight research aircraft demonstrated forward-swept wing technology and provided data on aeroelastic tailoring, active controls, and canard effects.

**NASA/FAA Wind Shear Program 1986-1993**

A joint study by NASA and the Federal Aviation Administration on the cause of wind shear resulted in a better understanding of corrective actions, outcome procedures, and technologies.

**Earth Observing System 1999-Present**

NASA launched its first series of EOS satellites from 1999 through 2004, and continues to upgrade and enhance this constellation of satellites to detect and measure global change. Observations from these satellites provide much of the basis of our understanding of climate change, and find myriad applications in our economy and society.

**International Space Station 1993-Present**

Still under construction and orbiting 200 miles above, the International Space Station is yielding benefits here on Earth:

- A novel, quick-fastening nut for use in firefighting, aerospace, gas fittings, and manufacturing.
- Hand-held devices warn pilots of dangerous or deteriorating cabin pressure.
- An air purifier kills 93.3 percent of airborne pathogens, including anthrax.
- Robotic arms assist in human-collaborative medical surgery and emergency response to chemical, biological, and nuclear material spills.
- Reverse osmosis technology is used to clean the water runoff from landfills.
- Superelastic and high-damping golf clubs.
- A video headset offers people with low vision a view of their surroundings.
- 360° immersive digital representations provide consumers with views of the latest automobiles, hotel accommodations, and real estate.

**Hubble Space Telescope 1990-Present**

Perhaps the world's most famous telescope, Hubble has given us more than close-up views of our galaxy:

- Surgeons perform micro-invasive arthroscopic surgery with increased precision.
- Precision optics and advanced scheduling software optimizes semiconductor manufacturing.
- Software allows astronomers to locate, identify, and acquire images of deep sky objects.
- Imaging technology makes breast biopsies less invasive and more accurate.

**Environmental Research Aircraft and Sensor Technology (ERAST) 1994-2003**

The remotely piloted, solar-powered "Helios" vehicle flew to the record-breaking altitude of 96,863 feet, leading the way for future high-altitude, long-duration, solar-powered aircraft.

**NASA's 50th Anniversary 2008**

Over the next 50 years, NASA will continue its legacy of creating cutting-edge technologies. What follows is a blueprint of the Agency's designs for the future.

**2009**

The Ares I-X is NASA's first test flight for the Agency's Constellation launch vehicles; it will employ a space shuttle-derived solid rocket booster and upper stage engine similar to those used on the Apollo spacecraft.

Mars Science Laboratory: A long-duration rover/mobile scientific laboratory equipped to perform many studies of Mars.

Kepler: This NASA Discovery mission is specifically designed to survey our region of the Milky Way Galaxy to detect and characterize hundreds of Earth-size and smaller planets in or nearby the "habitable zone" where liquid water can exist on a planet's surface.

**2010**

Planned completion of the International Space Station.

**2012**

The Soil Moisture Active/Passive mission will inaugurate a new series of Earth observing missions for science and applications.

The Radiation Belt Storm Probes will begin the next wave of missions to understand how our Sun wields its governing influence over our solar system.

**2013**

Mars scout missions: Future unmanned missions will involve airborne vehicles and small landers that serve as investigation platforms.

James Webb Space Telescope: JWST, the successor to the Hubble Space Telescope, will find the first galaxies that formed in the early universe, connecting the Big Bang to our own Milky Way galaxy.

**2015**

First crewed flight of Orion: Before any journeys to the Moon, the new Orion crew capsule will be used to ferry crew members and supplies to the International Space Station.

**2020-2050**

- New robotic missions to the other planets and small bodies in our solar system will reveal our solar system's history and the potential for life elsewhere.
- Manned mission to Mars
- Additional space telescopes: If the Terrestrial Planet Finder discovers extrasolar planets with evidence of life, NASA would pursue additional space telescopes that can confirm the existence of life on these worlds and image their features. A human presence in deep space could be necessary to help erect and upgrade such future telescopes.
- Lunar outpost construction begins.