Grantee

The material contained in this document is based upon work supported by a National Aeronautics and Space Administration (NASA) grant or cooperative agreement. Any opinions, findings, conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of NASA.

#LOOKUP.

Whether your interests include aerospace, biology, history, international relations, economics or mythology, there has never been a more exciting time for humanity's pursuits in space. Yours is the generation that will set foot on Mars.

This publication is a journey through our collective memories, accomplishments and future challenges, and we hope that it serves not only as a guide for learning, but also an opportunity to bring together generations to share a story or two around the brilliant flame of a rocket in the night sky.

Space exploration is much more than "something that someone else" does; it is part of the identity of all humans. The International Space Station still serves as a collaborative learning lab, even as countries compete for scientific knowledge and race to stake claims on the moon and Mars. Space exploration impacts politics and political priorities in ways previously unseen, presents enormous opportunities for local, national and global economies, and could unlock keys to human survival here on our planet.

To our students: whether you are interested in aerospace, healthcare, engineering, natural science, art, writing or history, the space economy has space for you.

Space4All may be the first time you consider how your journey will be impacted by space exploration; or it may be a pathway to enjoy the things that already interest you. In any case, share your excitement through social media. Pay close attention to the work of the people who work under the logos of NASA, SpaceX, Blue Origin and other space-related organizations. There is plenty of space for you to dream big.

I trust that we have created an opportunity for teachers, librarians, families and students to share an appreciation for space exploration and a renewed spirit of exploration and amazement in the process. In many cases, it is as simple as taking time together to #LookUp.

Larry R. Plank, Ed.S.
Assistant Professor of Science Education, University of South Florida
President, Tampa Bay STEM Network

1950s

THE SPACE RACE BEGINS

First pass of Echo 1 over the Goldstone Tracking Station in California on the morning of Aug. 12, 1960. NASA/JPL-Caltech

Sputnik 1. National Air and Space Museum

Above: Explorer 1. National Air and Space Museum

Sputnik: the first artificial satellite

The era of human exploration of space began on Oct. 4, 1957, when the former Soviet Union launched the first artificial satellite, Sputnik, into orbit around the Earth. "Sputnik" means "companion" or "satellite" in Russian.

Sputnik was about the size of a beach ball and weighed 184 pounds. It sent out beeps from a radio transmitter that could be detected on the ground as the satellite passed overhead.

The satellite transmitters operated for three weeks. Sputnik remained in orbit for about three months.

The first successful launch of an American satellite, Explorer 1, occurred on Jan. 31, 1958. Explorer 1 was the first satellite to carry scientific instruments into space.

Throughout the remainder of the 1950s and into the 1960s, satellite technology continued to push the boundaries of space exploration.

WHY IS THIS IMPORTANT?

The launch of the first artificial satellite marked the start of the space age and the "Space Race." Today, more than 7,500 satellites orbit Earth. More than half are used for communications, including television, telephones, radio and the Internet. Other uses include Earth and space observation, Earth and space science, and navigation (GPS). The Union of Concerned Scientists keeps a database with details on the satellites currently orbiting Earth at ucsusa.org/resources/satellite-database.

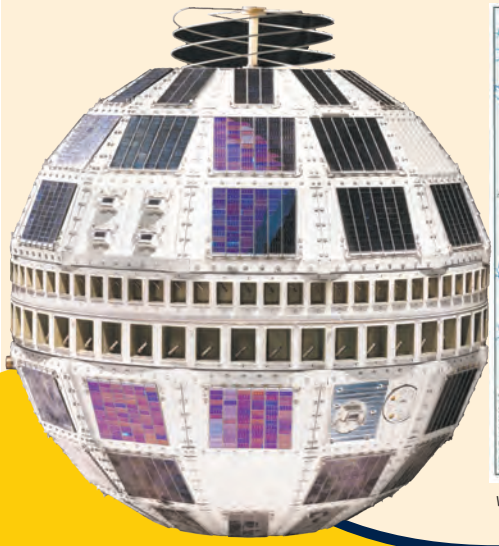
CONTEXT: THE SPACE RACE AND THE COLD WAR

The successful launch of Sputnik began the "Space Race" between the U.S. and Soviet Union.

The Space Race was an important part of the Cold War, a conflict between the United States and the Soviet Union. After the end of World War II, the U.S. and the Soviet Union were the two most powerful countries in the world. Although they never fought a war against each other, they competed on military, political and technological fronts for almost 50 years. The two countries competed to build new technologies and to reach new milestones in space exploration. This became known as the Space Race.

The Soviet Union, or Union of Soviet Socialist Republics (U.S.S.R.), existed from 1922 to 1991. It consisted of 15 socialist republics, of which the largest and most powerful was the Russian republic. The Soviet Union dissolved in 1991, becoming 15 separate countries, the largest of which is Russia.

Sources: Dewesoft, National Air and Space Museum; National Aeronautics and Space Administration (NASA); National Geographic, Union of Concerned Scientists



Telstar 1. National Air and Space Museum

www.visualcapitalist.com

GOING BEYOND THE TEXT:

Evaluating scientific arguments in the news

In everyday life, an argument is a disagreement between people. But in science, an argument is a statement backed by evidence. The purpose of a scientific argument is to answer a question about the natural world. The basic components of an argument are:

1. **Claim:** A statement backed by evidence.
2. **Evidence:** The information (data or observations) that supports the claim. It should be objective and based on facts.
3. **Reasoning:** The explanation of how the evidence supports the claim. It should rely on accepted scientific theories and concepts.

Find an article about science in the Tampa Bay Times. Read through the article and write down your answers to the following questions as an outline or on a graphic organizer.

1. What is the claim?
2. What evidence is provided to support the claim?
3. What parts of the claim are supported by each data point or observation? You may find it helpful to mark up the article with highlights, underlining, circling or numbering.

As a class, discuss:

- Does the article present a strong argument? Why or why not? How might it be improved?
- How does the information in the article connect with what you've learned in science class?
- How does the information in the article relate to you, your community or society in general?
- What did you find interesting or surprising about the article?

Echo 1. National Air and Space Museum

Sources: BioInteractive.org, Evaluating Science in the News; The Lawrence Hall of Science, Argumentation Toolkit

Florida Standards: SS.58.A.1.1; SC.58.N.1.5; ELA.58.R.2.4; ELA.K12.EE.1.1; ELA.K12.EE.2.1; ELA.58.C.1.3; ELA.58.C.1.5; ELA.58.C.3.1; ELA.58.C.4.1; ELA.58.F.1.4; ELA.58.R.2.2; ELA.58.R.2.3; ELA.58.R.2.4; ELA.58.V.1.3

SPACE EXPLORATION TIMELINE

1957

Oct. 4 – The Soviet Union launches the first artificial satellite, Sputnik, into space. Sputnik means "companion" or "satellite" in Russian.

1958

Jan. 31 – The United States launches its first satellite, Explorer 1.

1959

Oct. 4 – The Soviet satellite Luna ("Moon") 3 launches, orbits the moon and photographs the moon's far side for the first time.

1960

April 1 – The U.S. launches TIROS 1, the first weather satellite.
Aug. 12 – The U.S. launches ECHO 1, the first communications satellite.
Aug. 19 – The U.S.S.R. launches Sputnik 5, carrying the dogs Strelka and Belka. They become the first living beings to survive a trip into space.

1961

April 12 – Soviet cosmonaut Yuri Gagarin becomes the first human in space. Gagarin completes one orbit of Earth.
May 5 – Astronaut Alan Shepard completes a 15-minute suborbital flight and becomes the first American in space.
May 25 – President John F. Kennedy challenges the country to put a man on the moon by the end of the decade.

1962

Feb. 20 – Astronaut John Glenn becomes the first American in orbit. Glenn completes three orbits of Earth.
June 16 – Cosmonaut Valentina Nikolayeva Tereshkova becomes the first woman in space.
July 10 – The U.S. launches Telstar I, the first active communications satellite and the first satellite launched for a private company, AT&T.

1965

March 18 – Cosmonaut Alexi Leonov becomes the first man to walk in space.
June 3 – Astronaut Ed White becomes the first American to walk in space.

1966

Feb. 3 – The Soviet spacecraft Luna 9 becomes the first spacecraft to make a soft landing on the moon and transmit pictures back to Earth.
April 3 – The Soviet spacecraft Luna 10 becomes the first spacecraft to orbit the moon.
June 2 – The U.S. spacecraft Surveyor 1 becomes the first American spacecraft to land on the moon.

RACE TO THE MOON 1960s

A decade of firsts

The 1960s saw the beginning of crewed space exploration and a series of firsts:

On April 12, 1961, Soviet cosmonaut **Yuri Gagarin** became the **first human in space**, when he completed one orbit of Earth in the Soviet spacecraft Vostok ("East")1. The flight lasted 108 minutes.

Yuri Gagarin. NASA

On May 5, U.S. astronaut **Alan Shepard** became the second human and the **first American in space**, when he completed a 15-minute suborbital flight in the spacecraft Freedom 7.

On Feb. 20, 1962, astronaut **John Glenn** became the **first American in orbit**, completing three orbits of Earth in the spacecraft Friendship 7.

On June 16, 1962, cosmonaut **Valentina Nikolayeva Tereshkova** became the **first woman in space**, making 48 orbits of Earth in the spacecraft Vostok 6. Her flight lasted more than 70 hours.

John Glenn. NASA

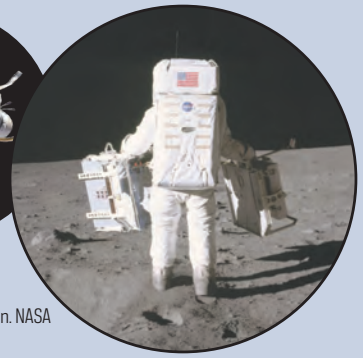
On March 18, 1965, cosmonaut **Alexi Leonov** became the **first human to walk in space**, performing the first tethered spacewalk outside his spacecraft Voskhod ("Sunrise") 2 while in Earth's orbit.

On June 3, astronaut **Ed White** became the **first American to walk in space**. His spacewalk lasted 23 minutes.

On Dec. 21, 1968, astronauts **Bill Anders, Frank Borman and Jim Lovell** became the **first humans to orbit the moon** and the **first humans to see the Earth from lunar orbit**.

On July 20, 1969, astronauts **Neil Armstrong and Edwin "Buzz" Aldrin** became the **first humans to walk on another celestial body**, the moon.

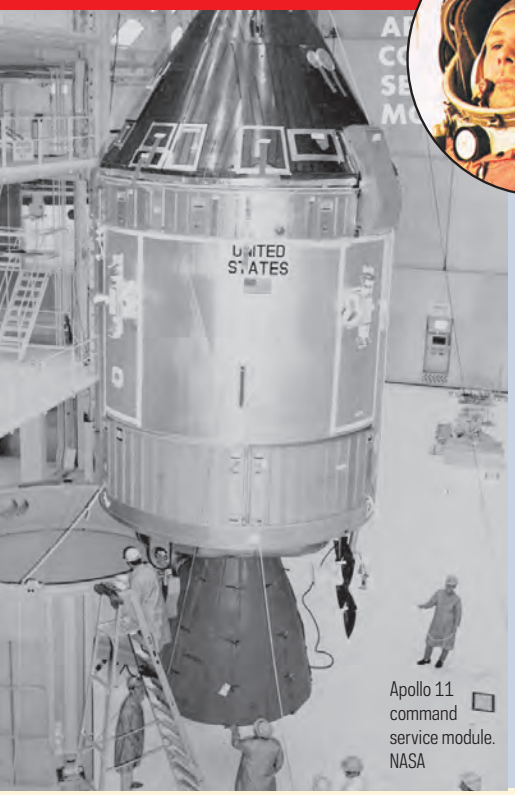
Ed White. NASA



"Buzz" Aldrin. NASA

WHY IS THIS IMPORTANT?

From 1969 through 1972, twelve astronauts landed on and explored the moon. For the more than 50 years since then, no human being has landed on another celestial body – but that's about to change! NASA's Artemis program – which is a partnership between NASA, the Canadian, European, Japanese and UAE space agencies, and private companies including SpaceX and Blue Origin – is planning a crewed mission to the moon in 2027. Artemis' ultimate goals include establishing a lunar base and space station and preparing for crewed missions to Mars.



Apollo 11 command service module. NASA

GOING BEYOND THE TEXT:

Apollo landing sites

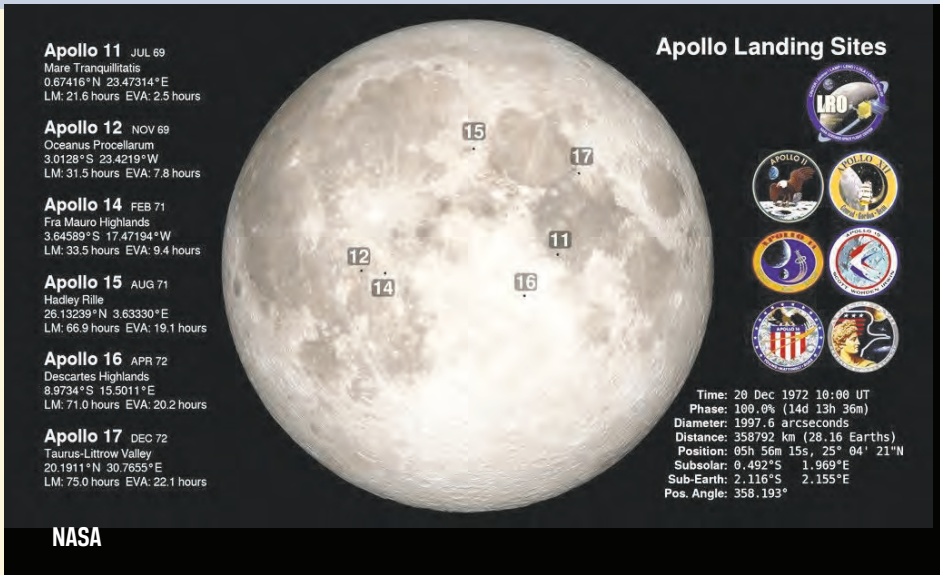
Twelve astronauts in six Apollo missions landed on and explored the near side (Earth-facing side) of the moon from 1969 through 1972. The six landing sites were chosen to explore different geologic terrains. In addition to scientific interest, NASA had to consider mission success and astronaut safety when choosing landing sites.

In six small groups, research the Apollo 11, 13, 14, 15, 16 and 17 missions and landing sites. Two good places to start are science.nasa.gov/moon/missions and lpi.usra.edu/lunar/missions.

Why was the landing site chosen? What were the mission objectives? Were they achieved? Share your research with the class.

Sources: NASA, Choose Your Landing Site

Florida Standards: ELA.58.EE.1.1; ELA.58.EE.2.1; ELA.58.EE.3.1; ELA.58.EE.4.1; ELA.58.EE.5.1; ELA.58.EE.6.1; ELA.58.C.1.3; ELA.58.C.1.5; ELA.58.C.2.1; ELA.58.C.3.1; ELA.58.C.4.1; ELA.58.F.1.3; ELA.58.F.1.4; ELA.58.R.2.2; ELA.58.R.2.3; ELA.58.R.3.2; ELA.58.V.1.1



Astronaut or cosmonaut?

Astronaut refers to a person engaged in or trained for spaceflight. Cosmonaut is the term used for a Russian or Soviet astronaut.

- Dictionary.com

"Buzz" Aldrin during Apollo 11. NASA

Close-up view of an astronaut's footprint in the lunar soil. NASA

Apollo program mission patch. NASA

Apollo 11: First man on the moon

"That's one small step for (a) man; one giant leap for mankind."

- Astronaut Neil Armstrong, as he stepped onto the lunar surface, July 20, 1969

Apollo program

On May 25, 1961, President John F. Kennedy challenged the nation to land astronauts on the moon by the end of the decade. The Apollo program was created by NASA to meet that challenge.

The Apollo spacecraft held three people and had three parts: the command module, the service module and the lunar module. A total of 12 astronauts walked on the moon during the Apollo program.

Apollo 11 launched on July 16, 1969, carrying Commander Neil Armstrong, Command Module Pilot Michael Collins and Lunar Module Pilot Edwin "Buzz" Aldrin.

At 1:44 p.m. ET on July 20, the Lunar Module, named Eagle, undocked from the command and service module with astronauts Armstrong and Aldrin aboard. It landed on the moon's surface at 4:17 p.m. Armstrong radioed: "Houston…Tranquility Base here. The Eagle has landed."

At 10:51 p.m., Armstrong stepped onto the moon, followed by Aldrin about 20 minutes later. About 650 million people watched Armstrong's televised image and heard his voice describe the event as he took "…one small step for (a) man, one giant leap for mankind."

Armstrong and Aldrin spent a total of 21 hours and 36 minutes on the moon's surface, and more than two-and-a-half hours outside their spacecraft carrying out a series of experiments.

Sources: National Air and Space Museum; NASA

St. Petersburg Times

Moon, We're Onto You

Americans Land On Moon's Plain

Man's Boundary: Always One Step Away

THE TAMPA TRIBUNE

Man on The Moon

First Footsteps In New World All American

Veni, vidi, vici

'Small Step For Man…Giant Leap For Mankind'

GOING BEYOND THE TEXT:

A decade of "firsts"

The 1960s were a decade of many "firsts" in the space program. Each "first" was a steppingstone to further achievements and discoveries. Find a story about a science or technology "first" in the Tampa Bay Times. Why is this discovery significant? What further achievements or discoveries might it lead to? Using the articles in the Tampa Bay Times as models, write an article from the point of view of a reporter in the year 2075 who has been assigned to write about the significance of this "first" from 2024.

Florida Standards: ELA.58.EE.1.1; ELA.58.EE.2.1; ELA.58.EE.3.1; ELA.58.EE.5.1; ELA.58.C.1.3; ELA.58.C.1.4; ELA.58.C.1.5; ELA.58.C.3.1; ELA.58.C.4.1; ELA.58.F.1.3; ELA.58.F.1.4; ELA.58.R.2.1; ELA.58.R.2.2; ELA.58.R.2.3; ELA.58.V.1.1

APOLLO PROGRAM

1967

Oct. 18 – The Soviet space probe Venera ("Venus") 4 sends a capsule to descend into the atmosphere of the planet Venus. It is the first probe to perform in-place analysis of the environment of another planet.

1968

Sept. 15 – The Soviet spacecraft Zond ("Probe") 5 launches. It becomes the first spacecraft to orbit the moon and return safely to Earth. It also carries the first terrestrial organisms to the moon.

Dec. 21 – The U.S. mission Apollo 8 launches. Astronauts Bill Anders, Frank Borman and Jim Lovell become the first humans to orbit the moon and the first humans to see Earth from lunar orbit.

1969

July 20 – Astronauts Neil Armstrong and Buzz Aldrin become the first humans to walk on another celestial body, the moon, during the U.S. Apollo 11 mission.

1970

April 11 – The U.S. mission Apollo 13 launches, crewed by astronauts Jim Lovell, John "Jack" Swigert and Fred Haise. Just under 56 hours into the mission, an oxygen tank in the service module explodes, forcing the crew to use the small lunar module as a lifeboat. After more than three days circling the moon, the crew returns safely to Earth.

Sept. 12 – The Soviet spacecraft Luna 16 launches. It becomes the first automatic spacecraft to return soil samples of the moon.

Nov. 17 – The Soviet spacecraft Luna 17 lands on the moon with the first automatic robot, Lunokhod ("Moonwalker") 1.

Dec. 15 – The Soviet spacecraft Venera 7 lands on Venus, becoming the first probe to make a soft landing on another planet.

1971

April 19 – The U.S.S.R. launches the space station Salyut ("Salute") 1, the first space station in orbit around Earth.

July 30 – Astronauts David Scott and James Irwin drive the first Lunar Roving Vehicle, also known as the Moon Buggy, on the surface of the moon.

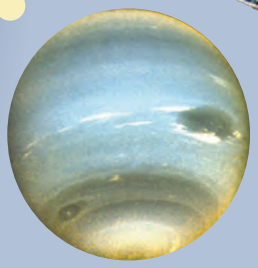
Nov. 13 – The U.S. Mariner 9 probe reaches Mars and becomes the first spacecraft to orbit another planet.

Dec. 2 – The Soviet lander Mars 3 becomes the first spacecraft to soft-land on Mars.

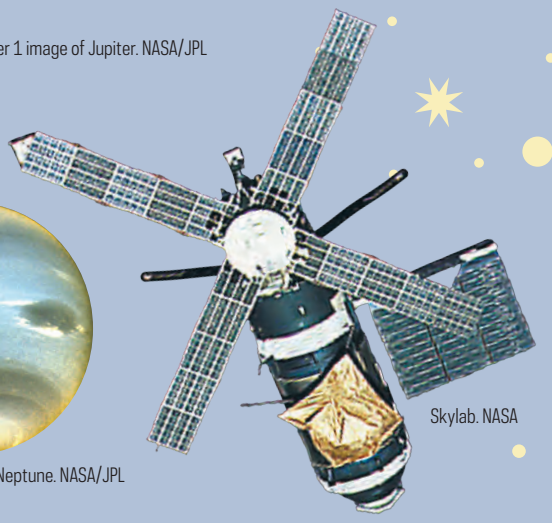
1970s

BEYOND THE MOON

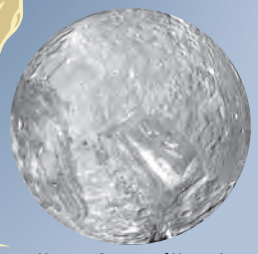
Voyager 1 image of Jupiter. NASA/JPL



Voyager 2 image of Neptune. NASA/JPL



Skylab. NASA



Voyager 2 image of Uranus' icy moon Miranda. NASA/JPL-Caltech

WHY IS THIS IMPORTANT?

Starting in the 1970s, uncrewed spacecraft have helped to expand the boundaries of exploration beyond where human beings can go in person. Since then, uncrewed orbiters, landers and rovers have expanded human knowledge by exploring the far side of the moon, Mars, Mercury, Venus, Jupiter and Saturn, as well as asteroids and comets.

Skylab 1 mission patch. NASA

Voyager 1 image of Jupiter's moon Io. JPL

The first space stations

During the 1970s, humans established a more permanent presence in space.

The world's first space station, Salyut ("Salute") 1, was launched by the U.S.S.R. in 1971. Salyut carried scientific equipment to observe Earth, make astronomical observations and study the effects of spaceflight on the human body. Salyut 1 stayed in space for 175 days, with crew aboard for 24 days. During the next ten years, the U.S.S.R. launched six more Salyuts and conducted a total of 32 missions to them.

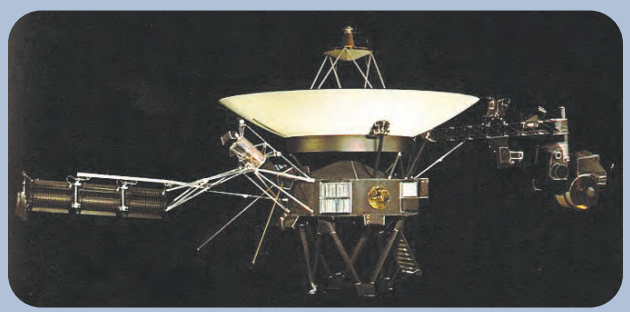
In 1973, the U.S. launched Skylab, the first U.S. space station. Three crews of three astronauts each would inhabit Skylab for a total of 171 days. Skylab was equipped with instruments and experiments to observe the Earth and Sun, study the effects of weightlessness on the human body and perform experiments submitted by high school students for a "Classroom in Space."

The farthest explorers ever

The Voyager 1 and 2 spacecraft were launched in 1977 to explore Jupiter and Saturn. The spacecraft were built to last five years, but they were still functioning after having completed all their objectives, so their mission was extended.

Voyager 2 went on to explore Uranus and Neptune. It is still the only spacecraft to have visited those outer planets. Between them, Voyagers 1 and 2 explored all the giant outer planets and 48 of their moons.

The Voyagers have now become the only spacecraft in history to leave our solar system and enter interstellar space. Their mission has been renamed the Voyager Interstellar Mission (VIM) and will measure interstellar magnetic fields, particles and plasma waves in interstellar space. Learn more about Voyager at science.nasa.gov/mission/voyager.



Full-scale model of Voyager 2. NASA

WHERE ARE VOYAGER 1 AND 2?

Both Voyager 1 and Voyager 2 have reached interstellar space and each continue their unique journey deeper into the cosmos. See where Voyager 1 and 2 are now at science.nasa.gov/mission/voyager/where-are-voyager-1-and-voyager-2-now.

Right: Engineers working on Voyager 2. NASA/JPL-Caltech

Apollo spacecraft as seen from Soyuz. NASA/U.S.S.R. Academy of Sciences

Apollo-Soyuz Test Project: "Handshake in Space"

The Apollo-Soyuz Test Project was the first international human spaceflight.

On July 15, 1975, an American Apollo spacecraft launched carrying a crew of three astronauts. Two days later, it docked with a Soviet Soyuz ("Union") spacecraft and its crew of two cosmonauts.

The Apollo-Soyuz mission lasted nine days. The cosmonauts and U.S. astronauts carried out five joint experiments and exchanged gifts including U.S., Soviet and United Nations flags, commemorative plaques, medallions, certificates and tree seeds.

Although it would be two decades before the countries teamed up again, the successful Apollo-Soyuz Test Project paved the way for future international partnerships.

View the Apollo-Soyuz "Handshake in Space" at youtube.com/watch?v=es7Br9kJBbo.

Official emblem of the Apollo-Soyuz Test Project. NASA

TYPES OF UNCREWED SPACECRAFT

A **space probe** is an unpiloted, uncrewed spacecraft sent to explore space and gather scientific information. Types of probes include:

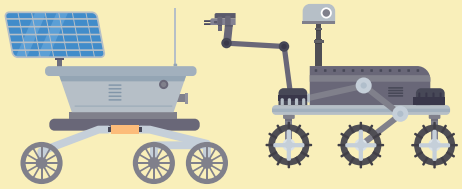
Flyby spacecraft follow a continuous solar orbit or escape trajectory and never enter into a planetary orbit.

Orbiters are designed to travel to another celestial body and enter into orbit around it.

Landers are designed to land on the surface of a celestial body. They do not move around.

Rovers are robotic vehicles designed to explore the surface of a celestial body.

Sources: National Air and Space Museum; NASA; National Archives; National Geographic



GOING BEYOND THE TEXT:

How far away are the Voyagers?

Because distances in space are so large, astronomers often describe them using astronomical units, or AUs. One AU is equal to the average distance between the Sun and Earth, about 93 million miles or 150 million kilometers.

Voyager 1 and 2 are now the most distant human-made objects from Earth in the universe. Voyager 1 is more than 15 billion miles away, and Voyager 2 is more than 12 billion miles away.

In this activity, you will build a scale model of the solar system to help visualize just how far the Voyager spacecraft have traveled.

Your model will use a scale of 10 centimeters per 1 AU. That means that 10 centimeters in the model scale represents 1 AU, or 93 million miles, in real life.

For each of the objects listed, multiply the scale factor of 10 centimeters by the distance from the sun in astronomical units (AU). For example, for Earth, multiply 1.0 AU x 10 cm = 10.0.

Once you have calculated all of your measurements, create and display your scale model. You can use beads or other objects tied onto string for an indoor display, or sidewalk chalk or distance markers such as cones or ground stakes for an outdoor display. For each object, measure the distance you calculated and mark the location with a drawing or picture. Invite your classmates to tour your scale model.

Extension activity: Take a photograph of your scale model. Using the photos and captions in the Tampa Bay Times as models, write a caption explaining what the model represents and how it was created. Writing photo captions is challenging because it requires you to include a lot of information in a small space. When writing a caption, you should assume that the photo might be published by itself without an accompanying story. This means that the caption must include all the relevant information in no more than two or three sentences.

Sources: Journalism Education Association; NASA/JPL, Make a Scale Solar System

Florida Standards: MA.7.GR.1.5; MA.58. MTR.2.1; MA.7.NSO.2.2; MA.7.NSO.1.5; MA.6.NSO.4.2; ELA.58.C.5.1; SC.68.PE.3.1; SC.68.PE.3.2; SC.68.PE.3.3; SC.68.PE.3.4; SC.7.N.3.2; ELA.58.EE.5.1 ELA.58.EE.6.1; ELA.58.C.3.1

Object	Distance from sun (AU)	Scale value (centimeters)
Sun	0.0	0.0
Mercury	0.4	
Venus	0.7	
Earth	1.0	10.0
Mars	1.5	
Jupiter	5.2	
Saturn	9.6	
Uranus	19.2	
Neptune	30.0	
Voyager 2	138.4	
Voyager 1	165.6	

1972

July 23 – The U.S. launches its Landsat 1 satellite, beginning more than 40 years of continuous observations of Earth's land surfaces, oceans and atmosphere.

Dec. 11 – Eugene Cernan and Harrison "Jack" Schmitt become the last humans to walk on the moon.

1973

May 14 – The U.S. launches Skylab, the first U.S. space station.

Dec. 3 – The U.S. spacecraft Pioneer 10 becomes the first spacecraft to fly by Jupiter.

1975

July 17 – The U.S. spacecraft Apollo 18 and Soviet spacecraft Soyuz ("Union") 19 dock in the Apollo-Soyuz Test Project, the first joint mission between the U.S. and U.S.S.R.

Oct. 22 – The Soviet Venera 9 spacecraft lands successfully on Venus and sends the first pictures of the Venusian surface back to Earth.

1976

July 20 – The U.S. lander Viking 1 becomes the first spacecraft to successfully land on Mars and later performs the first Martian soil sample.

Sept. 3 – The U.S. lander Viking 2 lands on Mars. It later discovers and photographs water frost.

1977

Aug. 20 – The U.S. spacecraft Voyager 2 launches.

Sept. 5 – The U.S. spacecraft Voyager 1 launches.

1978

Dec. 4 – The U.S. Pioneer Venus Orbiter enters orbit around Venus and later deploys four probes into the Venusian atmosphere.

1979

March 5 – The U.S. Voyager 1 spacecraft arrives at Jupiter. Voyager 2 arrives on July 9.

Sept. 1 – The U.S. spacecraft Pioneer 11 becomes the first spacecraft to fly past Saturn, discovering another moon and another ring.

1980

Nov. 13 – Voyager 1 reaches Saturn and begins transmitting images.

1981

April 12 – The U.S. launches the first space shuttle, Columbia. The space shuttle is the world's first reusable spacecraft.

Aug. 26 - Voyager 2 reaches Saturn and begins transmitting images.

HUMANS IN ORBIT

In the 1980s and 1990s, America and the Soviet Union established more permanent occupancy in space.

Astronaut Bernard A. Harris, Jr. aboard the Space Shuttle Columbia. NASA

From left: Space shuttles Endeavour, Discovery and Atlantis lift off from Kennedy Space Center. NASA

GOING BEYOND THE TEXT:

Staying healthy in space

Space is a dangerous environment for humans, and it gets more dangerous the farther away from Earth humans go and the longer they stay in space.

Watch the short video "What we can learn from Scott Kelly's year in space" (5 minutes) at https://nieonline.com/tbtimes/videooftheweek.cfm?id=302.

Next, read the document "Gravity, Who Needs It? NASA Studies Your Body in Space" at nasa.gov/wp-content/uploads/2015/11/your_body_six_month_in_space_11_18_15_0.pdf.

If time allows, read more about the human body in space at nasa.gov/humans-in-space/the-human-body-in-space.

As a class, discuss:

- What are the biggest hazards for people spending a long time in space?
- Should we send people to Mars? Why or why not? Would you want to go?
- When do you think a crewed mission to Mars could take place?
- What could crewed missions do that uncrewed missions can't?
- Are robots better suited to space exploration than people?

Split the class into two groups. Each group will write an opinion article for or against human space exploration, using the opinion articles in the Tampa Bay Times as models. Groups should use the evidence they gathered during their research to back up their argument.

Florida Standards: SC.8.E.5.9; SC.8.E.5.10; ELA.58.EE.1.1; ELA.58.EE.2.1; ELA.58.EE.3.1; ELA.58.EE.4.1; ELA.58.EE.5.1; ELA.58.EE.6.1; ELA.58.C.1.3; ELA.58.C.2.1; ELA.58.C.3.1; ELA.58.C.4.1; ELA.58.C.5.1; ELA.58.F.1.3; ELA.58.F.1.4; ELA.58.R.2.1; ELA.58.R.2.2; ELA.58.R.2.3; ELA.58.R.3.2

Space Shuttle: The first reusable spacecraft

NASA's space shuttle was the first reusable spacecraft to carry humans into orbit. Five shuttles flew 135 missions and carried 852 people into space for 30 years from 1981 to 2011.

The space shuttle was unlike any other spacecraft built before it.

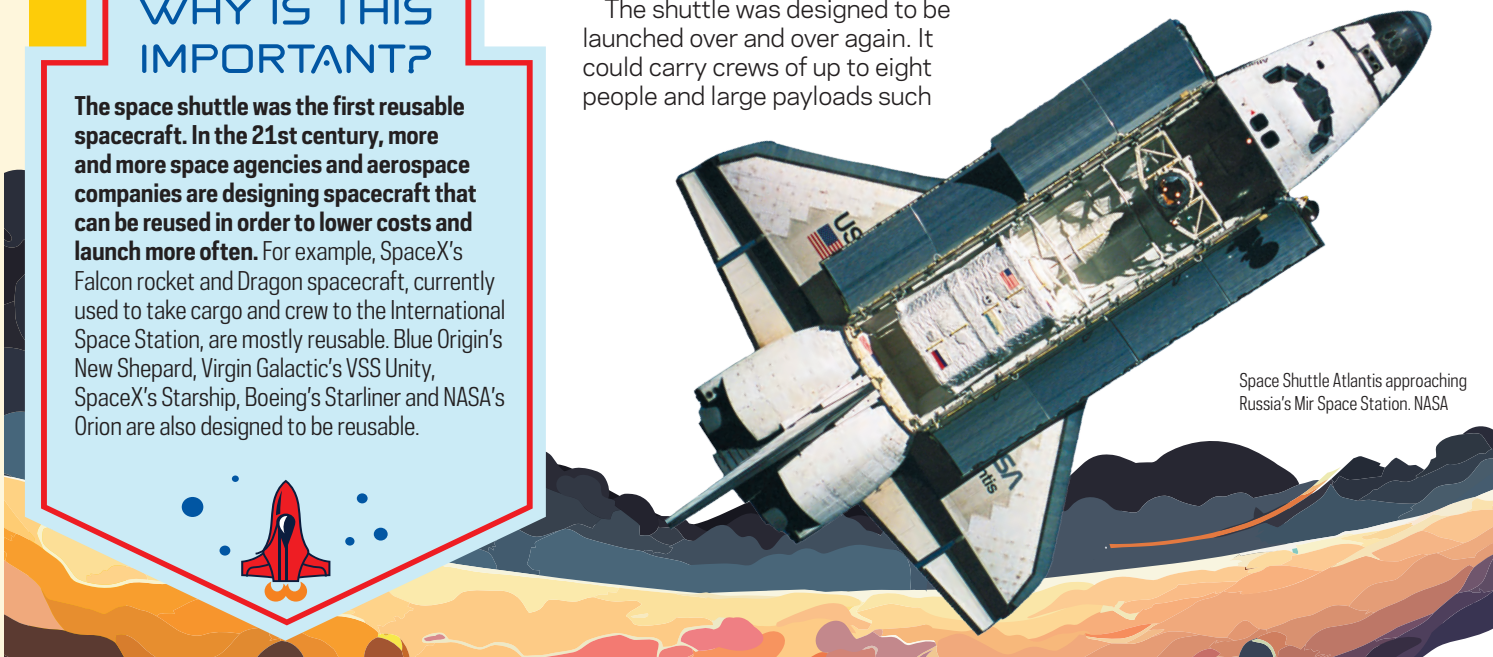
Earlier spacecraft consisted of one- to three-person capsules that launched on one-use rockets and returned to Earth by splashing down in the ocean (U.S.) or parachuting down onto a grassy plain (U.S.S.R.).

The shuttle was designed to be launched over and over again. It could carry crews of up to eight people and large payloads such as satellites to and from Earth's orbit. It launched like a rocket, but returned to Earth by gliding through the atmosphere to touch down on a runway like an airplane.

All of the shuttle's components were reused except for the external fuel tank, which burned up in the atmosphere after each launch.

WHY IS THIS IMPORTANT?

The space shuttle was the first reusable spacecraft. In the 21st century, more and more space agencies and aerospace companies are designing spacecraft that can be reused in order to lower costs and launch more often. For example, SpaceX's Falcon rocket and Dragon spacecraft, currently used to take cargo and crew to the International Space Station, are mostly reusable. Blue Origin's New Shepard, Virgin Galactic's VSS Unity, SpaceX's Starship, Boeing's Starliner and NASA's Orion are also designed to be reusable.



Space Shuttle Atlantis approaching Russia's Mir Space Station. NASA

MIR

The Soviet space station Mir ("Peace" or "World") was the first modular space station. Mir was constructed in space from separate parts, or modules, that were launched separately.

Mir's core module was launched into Earth's orbit in 1986. Over the next decade, five additional modules were launched and attached to the core module to create a large habitat and space laboratory. At the time, it was the largest spacecraft ever assembled.

From 1986 to 2000, Mir hosted 125 people from 12 countries, including 28 long-duration expeditions. Cosmonauts and astronauts from four countries completed 77 spacewalks. From January 1994 through March 1995, Mir cosmonaut-physician Valery Polyakov set an endurance record of 438 continuous days in space that still holds. Mir was only designed to last five years, but remained in service for 14 years and was continuously occupied for almost 10 years.

Astronauts and cosmonauts aboard Russia's Mir space station pose for a joint inflight NASA-Mir portrait. NASA/Russian Aviation and Space Agency.

SHUTTLE-MIR PROGRAM

The Shuttle-Mir Program was the first cooperative human space flight program between the United States and the U.S.S.R. since the Apollo-Soyuz Test Project.

In 1994, Space Shuttle Discovery launched with a Soviet cosmonaut aboard for the first time, and two American astronauts deployed to the Gagarin Cosmonaut Training Center in Star City outside of Moscow to begin training to fly on Mir.

From 1994 to 1998, American space shuttles rendezvoused with Mir ten times, and seven American astronauts spent a total of nearly 1,000 days living in orbit with Russian cosmonauts on Mir.

Sources: Encyclopaedia Britannica; National Air and Space Museum; NASA

Cosmonaut Yury I. Onufrienko on Russia's Mir Space Station. NASA

Above: Shuttle-Mir Program insignia. NASA

Left: Mir space station. NASA

1982

March 1 – The Soviet Venera 13 spacecraft lands on the planet Venus, providing the first scientific analysis of the Venusian soil.

1983

June 13 – Pioneer 10 becomes the first spacecraft to travel beyond the orbits of the known planets.
June 19 – Astronaut Sally Ride becomes the first American woman in space.
Aug. 30 – Astronaut Guion Bluford becomes the first African American in space.

1984

Feb. 3 – Astronaut Bruce McCandless becomes the first human to take an untethered spacewalk.
Oct. 11 – Kathryn Sullivan becomes the first American woman to walk in space.

1986

Jan. 24 – Voyager 2 arrives at Uranus, transmitting images and discovering 11 new moons.
Jan. 28 – The space shuttle Challenger explodes 73 seconds after liftoff, resulting in the deaths of the crew of seven astronauts.
Feb. 20 – The U.S.S.R. launches the core section of the Soviet Space Station Mir ("Peace" or "World"), the first modular space station in orbit.

1989

Aug. 25 – Voyager 2 arrives at Neptune, transmitting images, discovering previously unknown Neptunian rings and confirming six new moons.

1990

Aug. 10 – The U.S. spacecraft Magellan arrives at Venus and begins mapping the surface using radar equipment.
Aug. 24 – The space shuttle Discovery deploys the Hubble Space Telescope.

1991

Oct. 29 – NASA's Galileo probe performs the first asteroid encounter by a spacecraft.

1992

Sept. 12 – Astronaut Mae Jemison becomes the first African American woman in space.

1993

Nov. 17 – The United States, Russia, Japan, Canada and the European Space Agency announce they will cooperate in building the International Space Station (ISS).

1994

Feb. 3 – Cosmonaut Sergei Krikalev becomes the first Russian cosmonaut to fly aboard an American space shuttle, Discovery.

1995

Feb. 2 – Astronaut Eileen Collins becomes the first woman space shuttle pilot.

1997

July 4 – The U.S. spacecraft Mars Pathfinder lands on Mars. Its robotic rover, Sojourner, becomes the first rover to operate on another planet.

1998

Nov. 20 – Russia launches the first element of the International Space Station (ISS), the Zarya ("Sunrise") Control Module.
Dec. 6 – The crew of space shuttle Endeavor joins the U.S.-built Unity node to Zarya, officially beginning construction of the ISS.

1999

May 29 – Discovery becomes the first shuttle to dock to the International Space Station.
July 23 – STS-93 Columbia is the first shuttle mission to be commanded by a woman, astronaut Eileen Collins.
Nov. 20 – China launches its first unmanned spacecraft, the Shenzhou-1 ("Divine Ship").

2000s

SCIENCE IN SPACE

International Space Station (ISS)

NASA astronaut Nicole Stott in the Kibo laboratory of the International Space Station. NASA

The International Space Station (ISS) is the largest space station ever assembled. It was built mostly by the United States and Russia, and is now operated by the space agencies of the United States, Russia, Europe, Japan and Canada. The ISS orbits Earth in low Earth orbit (LEO) – about 250 miles above the surface – and completes an orbit every 90 minutes.

The first module was launched into space in 1998. Zarya ("Sunrise") was funded by the U.S. and built and launched by Russia. A month later, the U.S.-built connecting node Unity was launched, followed by the Russian-built Zvezda ("Star") module in 2000. The ISS currently has 43 international modules and elements installed, with the most recent module added in 2021.

The ISS has been continuously occupied since 2000. More than 270 people from more than 20 countries have visited the ISS.

The ISS and its unique environment allow scientists to conduct research that is not possible on Earth. Many experiments study how biological and physical processes happen in a microgravity (weightless) environment. Others conduct observation of Earth from LEO or study how the extreme conditions of space, such as extreme heat and cold, vacuum and radiation, affect various materials.

Top: The International Space Station. In the left foreground is the Soyuz MS-25 crew ship docked to the Prichal docking module. NASA
Above left: NASA astronaut Jeanette Epps in the International Space Station's Destiny laboratory module. NASA
Above right: NASA astronauts Loral O'Hara and Mike Barratt at work inside the International Space Station's Unity module. NASA

WHY IS THIS IMPORTANT?

Understanding the effects of long-duration spaceflight on humans is essential as we plan to establish bases on and around the moon and Mars. Space stations allow us to study what happens to the human body when it spends a long time in space.

GOING BEYOND THE TEXT:

Design a microgravity experiment

The objective of a microgravity experiment is to understand the role of gravity on something you want to study.

Because we live on Earth, we normally observe the characteristics and processes of physical, chemical and biological systems *under the action of gravity*. For example, when a seed germinates, gravity is why the roots go *down* and the shoots go *up*.

The essential questions behind microgravity experiments are:

- How would this system behave differently if I could somehow turn gravity off?
- What might I learn from such an experiment?

When a physical, chemical or biological system is brought into a laboratory that is orbiting Earth, the system will operate as if gravity has been turned off. This lets you see if the system behaves differently than it does on Earth, in gravity.

For example, an experiment might explore whether a seed germinates in space the way it germinates on Earth. Some of the questions to answer might include: Is gravity important for proper germination and maturation? What will happen if you take gravity away and allow a seed to germinate? Is it important to know if a seed germinates appropriately in space, and then goes on to grow to maturity? Why? Are some seeds better adapted for germination in microgravity than others?

As a class, brainstorm what other questions this type of experiment might answer.

Next, read the descriptions of the SSEP experiments that have already flown at ssep.ncesse.org/communities/experiments-selected-for-flight. In small groups, brainstorm and write down topic ideas for future SSEP experiments. Use the photos, articles and advertisements in the Tampa Bay Times for topic ideas. Then, choose one topic and come up with three to five questions that you would try to answer through this experiment. Share your topic and questions with your class.

Source: SSEP

Florida Standards: SC.6.N.1.5; SC.58.N.1.1; ELA.58.EE.1.1; ELA.58.EE.2.1; ELA.58.EE.3.1; ELA.58.EE.4.1; ELA.58.EE.5.1; ELA.58.EE.6.1; ELA.58.C.1.3; ELA.58.C.2.1; ELA.58.C.3.1; ELA.58.C.4.1; ELA.58.C.5.1; ELA.58.F.1.3; ELA.58.F.1.4; ELA.58.R.2.1; ELA.58.R.2.2; ELA.58.R.2.3; ELA.58.R.3.2

STUDENT SPACEFLIGHT EXPERIMENTS PROGRAM

The Student Spaceflight Experiments Program (SSEP) offers teams of students the opportunity to design microgravity experiments (experiments conducted in a weightless environment) and compete to have them flown to the ISS and be implemented by the astronauts. The program is designed to mirror how professional researchers work and to help prepare students for STEM careers.

Since the program began in 2010, more than 400 experiments designed and built by SSEP student researchers have flown in space. Teams from more than 200 communities across the U.S. and around the world have participated in the program – including schools in Brevard, Hillsborough, Marion, Pasco and Sarasota counties in Florida!

Two teams from Randall Middle School in Hillsborough County had experiments included in Mission 18, which launched in November 2024.

Students Sanjana Rao, Aadrita Roy, Nathan Bohra, Crystal Heidenreich and Lonappan John are investigating fenugreek growth in microgravity; while students Bridget Bohan and Jade Thorn's experiment explores the effects of microgravity on hydroponically grown dandelions.

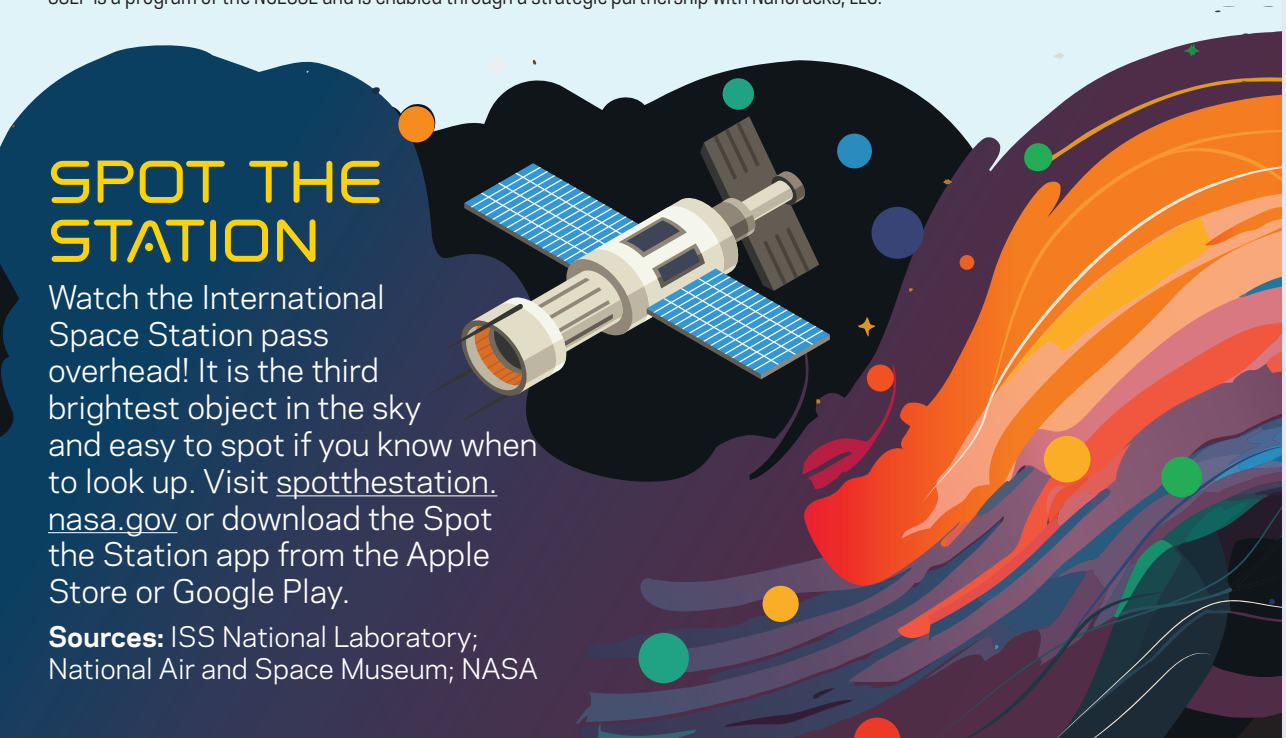
Randall Middle School students Bridget Bohan & Jade Thorn prepare their experiment for flight. Courtesy Mary Vaughn

To learn more about SSEP, including how your community can participate, visit ssep.ncesse.org.

Krinn Technical High seniors Shelly Nonnenberg, Amanda Marrero and Emily Null prepare bacteria samples for their research project. Jeffrey S. Solochek | Times (2020)

In 2020, students Amanda Marrero, Emily Null and Shelly Nonnenberg from Wendell Krinn Technical High School in Pasco County designed an experiment to determine whether antibiotics that kill bacteria related to staph and other infections would continue to work in space. Their experiment, *How will Microgravity Affect the Efficiency of Amoxicillin on S. Epidermis*, flew to the ISS in 2020 on SSEP Mission 14.

SSEP is a program of the NCESSE and is enabled through a strategic partnership with Nanoracks, LLC.



SPOT THE STATION

Watch the International Space Station pass overhead! It is the third brightest object in the sky and easy to spot if you know when to look up. Visit spotthestation.nasa.gov or download the Spot the Station app from the Apple Store or Google Play.

Sources: ISS National Laboratory; National Air and Space Museum; NASA

2000

Nov. 2 – Astronaut Bill Shepherd and cosmonauts Yuri Gidzenko and Sergei Krikalev board the ISS as Expedition 1 crew members, beginning humanity's permanent presence in space.

2001

April 28 – American Dennis Tito becomes the first space tourist, launching to the ISS in a Russian Soyuz spacecraft for an eight-day stay.

2003

Feb. 1 – The space shuttle Columbia breaks up on re-entry into Earth's atmosphere, resulting in the deaths of all seven crew members.

Oct. 15 – China launches the Shenzhou 5 spacecraft with the first Chinese astronaut, Yang Liwei, on board. This makes China the third country in the world to launch a crewed spacecraft.

2004

Jan. 3 – The U.S. rover Spirit lands on Mars. Designed to last only three months, Spirit continues to roam until 2009. It then continues to function as a stationary science platform until 2010.

Jan. 25 – The U.S. rover Opportunity, the sister rover to Spirit, lands on Mars. Opportunity continues to operate until 2018.

June 21 – Mojave Aerospace Ventures' SpaceShipOne is the first private, commercial spacecraft to be flown into space.

2005

Jan. 14 – The European Space Agency (ESA)'s Huygens probe lands on Saturn's moon Titan.

2006

Jan. 15 – The NASA spacecraft Stardust returns to Earth with the first samples ever collected from a comet.

2007

Nov. 5 – China's first lunar orbiter, Chang'e 1, enters the moon's orbit. Chang'e is the name of a mythological Chinese goddess who flew from Earth to the moon.

2008

May 25 – NASA's Phoenix Mars Lander lands on Mars and begins sending images back to Earth.

Sept. 25 – China launches the spacecraft Shenzhou 7, carrying three astronauts. Astronaut Zhai Zhigang makes the first Chinese spacewalk.

Oct. 22 – India launches the lunar orbiter Chandrayaan ("Moon Craft") 1, India's first deep space mission.

2010

June 13 – The Japanese spacecraft Hayabusa ("Falcon") returns the first samples from an asteroid to Earth.

Oct. 10 – Virgin Galactic, a private company, announces the successful first manned glide flight of the VSS Enterprise, a suborbital plane designed to take private citizens on suborbital space flights.

Dec. 8 – The commercial company SpaceX becomes the first non-government organization to launch a spacecraft into orbit and return it safely to Earth.

2010s

LANDERS AND ROVERS

Uncrewed spacecraft have played a crucial role in space exploration since the very beginning.

They can visit places that are difficult or impossible for humans to go to with existing technology, such as the surface of other planets. Some of the most important scientific discoveries of the space age would not have been possible without uncrewed spacecraft.

A lot of information about a planet can be gathered from flying by or orbiting it. But some information can only be gathered from the surface.

NASA's Spirit and Opportunity Mars rovers being tested. NASA/JPL-Caltech

Viking 2 Image of Mars. NASA/JPL

Tracks left by Opportunity. NASA/JPL-Caltech

Sojourner rover on Mars. NASA/JPL

Much of our knowledge of the surface of Mars comes from the many landers and rovers that have explored it during the past 50 years.

In 1971, the Soviet lander **Mars 3** became the first spacecraft to successfully land on Mars, but contact was lost just 20 seconds after it touched down. It was followed by the U.S. landers **Viking 1 and 2** in 1976, which took the first high-resolution photos of the surface and collected and analyzed the first Martian soil samples. Together, the Vikings returned 4,500 photos of Mars' surface.

In 1997, NASA's **Mars Pathfinder** mission successfully deployed the first-ever Mars rover, **Sojourner**. Mars Pathfinder returned more than 17,000 images, as well as weather data and chemical analyses of rocks and soil.

The next visitors to the surface of Mars were twin NASA rovers named **Spirit** and **Opportunity**. Landing in 2004 and expected to last 90 days, they explored Mars until 2010 (Spirit) and 2019 (Opportunity), driving more than 30 miles between them. Spirit and Opportunity found evidence that liquid water once existed on Mars.

In 2008, NASA's **Phoenix** lander touched down in Mars' northern polar region. Its mission was to search for evidence of water ice, which it found.

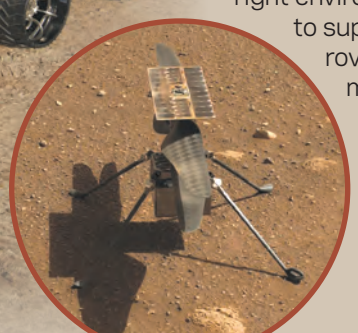
In 2012, NASA's **Mars Science Laboratory** landed on Mars, delivering the **Curiosity** rover. Curiosity's mission was to help answer the question of whether Mars ever had the right environmental conditions to support life. The rover has traveled 18 miles, drilled into 35 rocks and taken thousands of photographs. Its exploration mission continues.

NASA's **InSight** landed on Mars in 2018. It was the first mission to study the interior of Mars, with the goal of understanding how rocky planets like Earth and Mars formed and evolved.

China landed its first spacecraft on Mars in 2021. **Tianwen-1** ("Questions to Heaven") deployed the **Zhurong** rover, named for a mythological Chinese god of fire. The mission found evidence of an ancient ocean on Mars. China is only the second country to successfully land a rover on Mars.

NASA's **Mars 2020** mission arrived on Mars in 2021, delivering the **Perseverance** rover, marking the first time that three rovers traveled on Mars at the same time. Perseverance is searching for signs of ancient microbial life. It is also collecting core samples of Martian rock and regolith (broken rock and soil), for potential pickup by a future mission that would bring them back to Earth for study.

Perseverance delivered the Mars helicopter, **Ingenuity**, to the surface. Ingenuity completed 72 flights covering 10.5 miles. This tiny helicopter with a mass of less than four pounds was the first aircraft to achieve powered, controlled flight on another planet.



Sources: NASA, Reuters

Left: Two spacecraft engineers with three generations of Mars rovers developed at NASA JPL in Pasadena, California. Front and center is a flight spare of Sojourner; left is a working sibling to Spirit and Opportunity; right is test rover Curiosity. NASA/JPL-Caltech

Left: Ingenuity Mars helicopter on Mars, photographed by Perseverance. NASA/JPL-Caltech/ASU

GOING BEYOND THE TEXT:

Make a Cardboard Rover

Materials (per rover)

- 6-inch square of corrugated cardboard
- 2 5-inch squares of corrugated cardboard
- 1 sharpened round pencil
- 2 rubber bands
- 2 round hard candies with a hole in the middle
- 1 drinking straw
- Ruler
- Tape
- Scissors

Build your rover

1. Make the body of the rover: Fold the 6-inch square of cardboard into thirds. Each part will be about 2 inches across. Fold along (not across) the corrugation (the tubes inside a piece of cardboard).

2. Make the front wheels: On each 5-inch cardboard square, draw diagonal lines from corner to corner. Poke a small hole in the center where the lines cross.

3. Attach the front wheels: On the body, poke a hole close to the end of each side for the axle (pencil). Make sure the holes are directly across from each other and are big enough for the pencil to spin freely. Slide the pencil through the body's axle holes. Push a wheel onto each end and secure with tape.

NASA/JPL

4. Make the rear wheels: Tape the straw under the back end of the rover. Put a candy onto each end. Bend and tape the axle to keep the candies from coming off.

5. Attach the rubber band: Loop one end around the pencil. Cut small slits into the back end of the body. Slide the free end of the rubber bands into the slits.

Test, evaluate and redesign

Wind up the wheels, set the rover down, and let it go. Did everything work? Can you make your rover go farther? Engineers improve their designs by testing them. This is called the design process. Try redesigning the wheel setup or rubber band system. For example, wind up the wheels more; try wheels of different sizes or shapes; add another rubber band or use a rubber-band chain; add weight; put more wheels on the pencil; use bigger wheels.

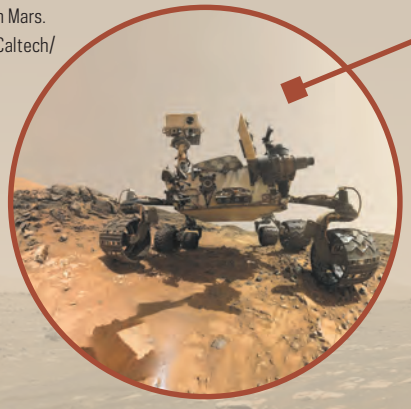
As a class, compare your final rover designs. How did you solve any problems that came up? How did you improve your rover's performance?

Extension activity: Keeping in mind the essential journalism questions – who, what, where, when, why and how – write a news article detailing the process you used to create the rover and any issues you encountered. Use the articles in the Tampa Bay Times as models. Share what you have learned during the process in the article and with your class.

Source: JPL, Make a Cardboard Rover

Florida Standards: SC.58.N.1.1; SC.58.N.1.2; SC.68.N.1.3; ELA.58.EE.1.1; ELA.58.EE.2.1; ELA.58.EE.3.1; ELA.58.EE.4.1; ELA.58.EE.5.1; ELA.58.EE.6.1; ELA.58.C.1.3; ELA.58.C.2.1; ELA.58.C.3.1; ELA.58.C.4.1; ELA.58.C.5.1; ELA.58.F.1.3; ELA.58.F.1.4; ELA.58.R.2.1; ELA.58.R.2.2; ELA.58.R.2.3; ELA.58.R.3.2

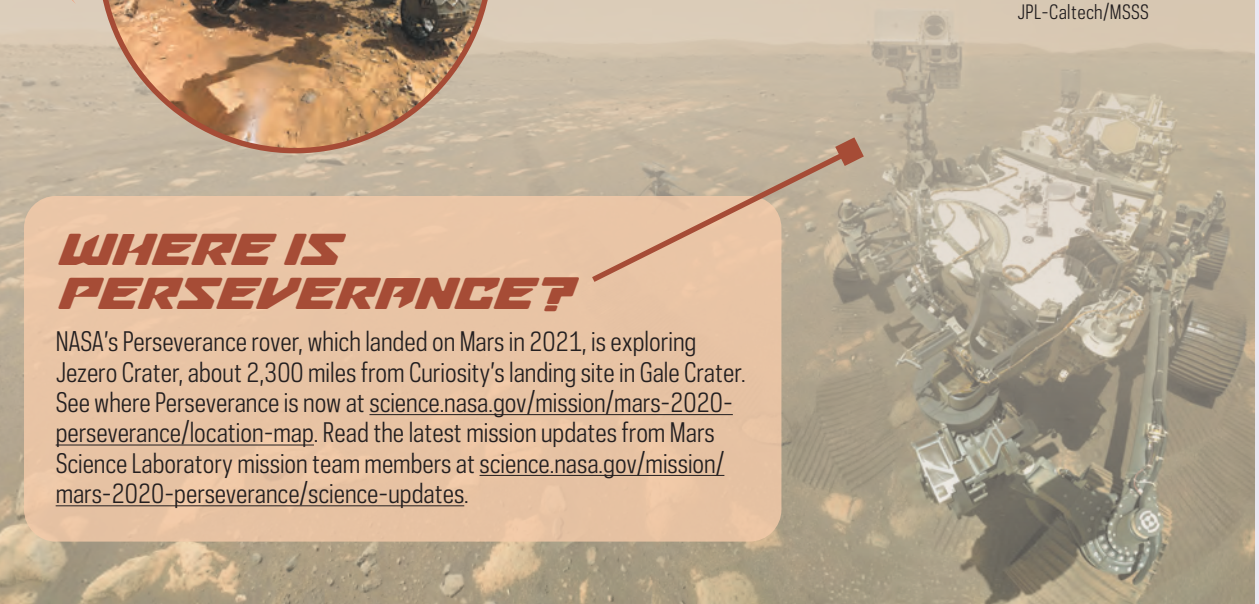
Curiosity on Mars. NASA/JPL-Caltech/MSSS



WHERE IS CURIOSITY?

NASA's Curiosity rover, which landed on Mars in 2012, is still exploring the planet's surface in 2024. See where Curiosity is now at science.nasa.gov/mission/msl-curiosity/location-map. Read the latest mission updates from Mars Science Laboratory mission team members at science.nasa.gov/mission/msl-curiosity/science-updates.

Perseverance on Mars. NASA/JPL-Caltech/MSSS



WHERE IS PERSEVERANCE?

NASA's Perseverance rover, which landed on Mars in 2021, is exploring Jezero Crater, about 2,300 miles from Curiosity's landing site in Gale Crater. See where Perseverance is now at science.nasa.gov/mission/mars-2020-perseverance/location-map. Read the latest mission updates from Mars Science Laboratory mission team members at science.nasa.gov/mission/mars-2020-perseverance/science-updates.

2011

March 18 – NASA's Messenger probe becomes the first spacecraft to orbit Mercury.
July 8 – Atlantis becomes the last American space shuttle to be launched into space.
July 16 – NASA's Dawn spacecraft becomes the first spacecraft to orbit an asteroid.
Sept. 29 – China launches Tiangong ("Heavenly Palace") 1, the first Chinese space lab.

2012

May 22 – SpaceX launches the first commercial ISS supply mission.
Aug. 6 – NASA's Curiosity rover successfully lands on Mars.
Aug. 25 – Voyager 1, launched in 1977, becomes the first spacecraft to reach interstellar space.

2013

Dec. 14 – China's Chang'e 3 probe lands on the moon and deploys the Yutu rover. It is the first moon landing since 1976. China becomes the third country, after the U.S. and the former U.S.S.R., to land on the moon. Yutu is the pet rabbit of the lunar goddess Chang'e in Chinese mythology.

2014

Aug. 6 – The ESA's Rosetta space probe becomes the first spacecraft to enter orbit around a comet.
Sept. 23 – India's Mangalyaan, or Mars Orbiter Mission, enters orbit around Mars. India becomes the fourth nation in the world, after the U.S., Russia and China, to successfully put a spacecraft in orbit around Mars.
Nov.12 – The ESA's Philae lander becomes the first spacecraft to make a soft landing on a comet.

2015

March 6 – NASA's Dawn spacecraft enters orbit around Ceres, becoming the first spacecraft to orbit a dwarf planet.
July 15 – NASA's New Horizons spacecraft flies by Pluto, sending back the first close-up views of the dwarf planet.
Aug. 10 – The crew of the ISS become the first astronauts to eat food grown in space.
Dec. 21 – SpaceX makes the first successful vertical landing of an orbital booster rocket.

2016

July 4 – NASA's Juno spacecraft reaches orbit around Jupiter.

2018

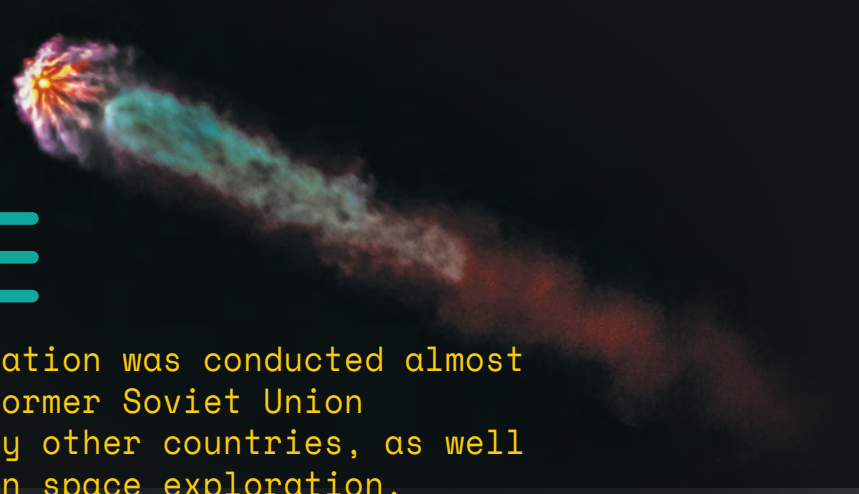
Sept. 21 – The Japan Aerospace Exploration Agency (JAXA)'s Hayabusa 2 spacecraft becomes the first to land moving rovers on the surface of an asteroid.
Nov. 5 – Voyager 2 reaches interstellar space.
Nov. 27 – NASA's Mars InSight lander lands on Mars.

2019

Jan. 3 – China's Chang'e 4 spacecraft makes the first-ever soft landing on the far side of the moon and deploys a lunar rover. The first seeds germinated on another celestial body are grown in a sealed biosphere on the lander.
Dec. 20 – The National Defense Authorization Act is signed into law, creating the U.S. Space Force.

2020s

A NEW SPACE RACE



For most of the 20th century, space exploration was conducted almost exclusively by the United States and the former Soviet Union (now Russia). But by the 21st century, many other countries, as well as private companies, began to take part in space exploration.

Space is international

In 2024, more than 70 countries have national space agencies. More than 500 astronauts from almost 40 countries have traveled to space. More and more countries can launch their own satellites, probes and even humans into space without using American or Russian facilities.

A SpaceX Falcon 9 rocket and Crew Dragon spacecraft lifts off from Kennedy Space Center. NASA

Private and commercial space exploration

Private companies have been partners with government space agencies since the beginning of the space age. But until recently, the only way to actually get to space was on a government-sponsored launch vehicle.

In 2010, the commercial company SpaceX became the first non-government organization to launch a spacecraft into orbit and return it safely to Earth. In 2012, it launched the first commercial supply mission to the ISS. In 2020, it was the first private company to launch astronauts into space, and in 2024, two civilians conducted the first private spacewalk on a SpaceX flight.

Other companies are focusing on space tourism. To date, 47 people have flown to space on Blue Origin's New Shepard, an autonomous, reusable suborbital rocket system.

Another private company, Virgin Galactic, uses a jet aircraft "mothership" to carry its spacecraft VSS Unity to an altitude of around 50,000 feet. It then releases the spacecraft, which continues to suborbital space using a rocket motor, then glides to a runway landing like the space shuttle. To date, 30 private astronauts have flown to space on VSS Unity.

Today, private, commercial companies routinely launch uncrewed spacecraft to low Earth orbit and carry cargo and crew to the International Space Station for NASA.

China is the third country in history, after the U.S. and U.S.S.R., to put a spacecraft into orbit around Mars, put human beings into space, to land a spacecraft on the moon, and to build a permanent space station. Its Tiangong ("heavenly palace") space station, completed in 2022, has three modules and supports three to six astronauts at a time.

India is the fourth nation in the world to successfully put a spacecraft in orbit around Mars and to land a spacecraft on the moon. India plans to put astronauts into orbit in 2026, which would make it the fourth country to independently launch people into space, after the United States, Russia and China.

Japan's space agency, JAXA, is a longtime partner of the U.S. The first Japanese astronauts flew on the space shuttle in 1990. In 2024, Japan became the fifth nation in history to put a spacecraft on the moon.

The European Space Agency (ESA) is made up of 22 European nations. Since its beginning in the 1960s, ESA has flown missions to the moon, Mars and Venus. ESA spacecraft were the first to land in the outer solar system and on the surface of a comet.

Above: A SpaceX Falcon 9 rocket soars upward after liftoff from Kennedy Space Center on a Commercial Resupply Services mission for NASA to the International Space Station. NASA

BACK TO THE MOON

Four nations – Russia, the United States, China and India – have successfully landed a spacecraft on the moon. The U.S. remains the only nation that has walked on the moon. No human being has been there since 1972.

NASA's Artemis program is scheduled to land the first woman, first person of color and first international partner astronaut on the moon in mid-2027, with ultimate goals including establishing a lunar base and space station and preparing for crewed missions to Mars. Artemis is a partnership of NASA, the Canadian, European, Japanese and UAE space agencies, and private companies including SpaceX and Blue Origin.

Blue Origin's New Shepard. Blue Origin

POSTCARDS TO SPACE

Blue Origin's Club for the Future offers everybody the opportunity to write a postcard to themselves and have it flown to space. Visit clubforfuture.org to learn more.

Sources: BBC; Blue Origin; Center for Strategic and International Studies; CIA World Factbook; Encyclopædia Britannica; European Space Agency; NASA; Reuters; SpaceX; Virgin Galactic

Astronaut Gopi Thotakura celebrates a successful mission to space in Blue Origin's New Shepard crew capsule. Blue Origin

Virgin Galactic's VMS Eve and VSS Unity in flight. Virgin Galactic

GOING BEYOND THE TEXT:

Space-related careers

Astronauts may be the most famous space workers, but they are vastly outnumbered by the scientists, engineers, technicians, and media and communications professionals who are essential to space-related projects.

Select a space-related occupation that seems interesting to you and research it using the U.S. Department of Labor Occupational Outlook Handbook at www.bls.gov/ooh and Career OneStop at careeronestop.org/ExploreCareers/explore-careers.aspx. Here are some ideas to get you started:

Scientists: Astronomers, atmospheric and space scientists, biologists, chemists, geologists, oceanographers, physicists
Engineers: Aerospace, chemical, computer hardware, electronic, mechanical, robotics, software
Technicians: Aerospace engineering, avionics, meteorological
Media and communications: Photographers, public relations, technical writers

Answer the following questions for the occupation you've researched:

- How does the occupation fit your skills and interests?
- What will you be doing in the occupation?
- What is the necessary education and/or training?
- How many jobs are there in the occupation currently?
- Is the occupation projected to grow, decline or remain unchanged? Why?
- How much does this occupation pay? What do the top 10 percent earn? The bottom 10 percent?

Prepare a report or presentation using the information you found. Would you pursue a career in the selected occupation? Present your findings to your class.

Extension activity: Find an article in the Tampa Bay Times about a person in a space-related or STEM-related career that you find interesting. Imagine that you are going to conduct an informational interview with this person (an informational interview is a meeting to learn about the real-life experience of someone working in a field that interests you). Write down the questions that you would ask.

Source: U.S. Bureau of Labor Statistics, Choosing a career: activity

Florida Standards: MA.7.AR.3.1; MA.6.AR.3.4; ELA.58.EE.1.1; ELA.58.EE.2.1; ELA.58.EE.3.1; ELA.58.EE.4.1; ELA.58.EE.5.1; ELA.58.EE.6.1; ELA.58.C.1.3; ELA.58.C.2.1; ELA.58.C.3.1; ELA.58.C.4.1; ELA.58.C.5.1; ELA.58.F.1.3; ELA.58.F.1.4; ELA.58.R.2.1; ELA.58.R.2.2; ELA.58.R.2.3; ELA.58.R.3.2

2020

Jan. 7 – Five chocolate chip cookies baked by the crew of the ISS become the first food to be baked in space.
May 30 – SpaceX becomes the first private company to launch astronauts into space.
July 23 – China launches the Tianwen-1 ("Questions to Heaven") probe to Mars, its first independent mission to another planet.
Dec. 1 – The Chinese Chang'e-5 probe successfully lands on the moon's surface and collects 2 kilograms (4.4 pounds) of lunar regolith samples, which are later returned to Earth. China becomes the third country, after the U.S. and U.S.S.R., to return lunar samples to Earth.

2021

Feb. 9 – The United Arab Emirates' Al-Amal ("Hope") Mars orbiter enters Mars orbit. The UAE becomes the fifth nation in the world, after the U.S., Russia, China and India, to successfully put a spacecraft in orbit around Mars.
Feb. 18 – NASA's Perseverance rover lands on Mars and later records the first sounds ever captured on the surface of Mars.
April 19 – NASA's Ingenuity Mars helicopter launches from the Perseverance Mars rover, becoming the first aircraft to make a powered, controlled flight on another planet.
April 28 – NASA's Parker Solar Probe becomes the first man-made spacecraft to enter the atmosphere of the Sun.
April 29 – China launches Tianhe ("Heavenly River"), the first module of its Tiangong space station, into low Earth orbit.
May 15 – China's Tianwen-1 spacecraft lands on Mars and deploys the Zhurong rover, marking China's first landing on another planet. China becomes the second country after the United States to land a robotic rover on the surface of Mars. Zhurong is the god of fire in Chinese mythology.
July 20 – The commercial company Blue Origin launches four private citizens to space aboard the New Shepard, an autonomous, reusable suborbital rocket system.
July 11 – The commercial company Virgin Galactic makes its first fully crewed flight, launching two pilots and four passengers into suborbital space aboard its spaceship VSS Unity.
Sept. 15 – SpaceX launches the first all-civilian astronaut crew into Earth orbit.
Dec. 25 – NASA launches the James Webb Space Telescope.

2023

June 1 – China's Chang'e 6 lunar lander lands on the far side of the moon. Chang'e collects about 2 kilograms (4.4 pounds) of samples and deploys a small rover. The samples are returned to Earth on June 25, marking the first samples from the far side of the moon returned to Earth.
Aug. 23 – India's Chandrayaan-3 lunar lander and rover land in the moon's south polar region.

2024

June 5 – Boeing launches two astronauts to the ISS aboard the Starliner spacecraft.
Sept. 12 – Two civilians – tech entrepreneur Jared Isaacman and SpaceX engineer Sarah Gillis – conduct the first private spacewalk on a commercial SpaceX flight.

Download an expanded version of this timeline at nieonline.com/tbtimes/curriculum_science.cfm#space.

Timeline sources: Encyclopaedia Britannica; ISS National Laboratory; NASA; National Archives; New York Times; Reuters; Sea and Sky

ABOUT THE

Tampa Bay STEM Network

The Tampa Bay STEM Network is one of more than 100 international STEM Learning Ecosystems formally recognized and supported by the Teaching Institute for Excellence in STEM (TIES). The Network, created in 2016, was one of the first STEM Learning Ecosystems participating in a community of practice to improve STEM educational opportunities for children and their families.

From its start in 2016, the Tampa Bay STEM Network has provided a wide-ranging portfolio of enjoyable learning experiences for students, teachers and families, resulting in the academic success of our community's children. They are dedicated to strengthening our local talent base, schools and STEM pipeline, contributing to the vitality of our community and ultimately to Building a Better Tampa Bay! Learn more at tbstem.org and facebook.com/TampaBaySTEM.

NASA Office of STEM Engagement

Grantee

This project is funded by a NASA Teams Engaging Affiliated Museums and Informal Institutions (TEAM II) Community Anchor Award, part of NASA's Next Generation STEM project. Next Gen STEM supports K-12 students, caregivers, and formal and informal educators in engaging the Artemis Generation in the agency's missions and discoveries.

NASA's Office of STEM Engagement (OSTEM) is committed to engaging, inspiring, and attracting future generations of explorers and building a diverse future STEM workforce through a broad set of programs, projects, internship opportunities, activities and products that connect students to NASA's mission, work and people.

Learn more at nasa.gov/learning-resources.

Pinellas Public Library Cooperative

The Pinellas Public Library Cooperative serves Pinellas County residents in member cities and unincorporated Pinellas County. The Cooperative provides coordination of programs, funding and marketing for the 14 member libraries. In 1992, PPLC established the Pinellas Talking Book Library to provide library services to the blind and physically handicapped. The Deaf Literacy Center was incorporated into the cooperative in 2000, to serve the deaf community.

Learn more at pplc.us.

About NIE

The Pulitzer Prize-winning Tampa Bay Times is the largest daily newspaper in Florida. Locally owned and independent, the Times has long been celebrated for its outstanding and credible journalism, practiced with integrity in the public interest. The Times has been part of the Tampa Bay community for more than 140 years.

The Tampa Bay Times Newspaper in Education program (NIE) is a cooperative effort between schools and the Times to encourage the use of newspapers in print and electronic form as educational resources – a "living textbook."

Since the 1970s, NIE has served educators, students, families and community members in the Tampa Bay area by providing class sets of the Times plus award-winning original educational publications, teacher guides, lesson plans, educator professional development resources and much more – all at no cost to schools, teachers or families.

NIE is a member of Florida Press Educational Services (FPES), a 501(c)(3) nonprofit organization of Florida newspaper professionals whose mission is to promote literacy, civic engagement and critical thinking, particularly for young people.

For more information about NIE, visit tampabay.com/nie, call 727-893-8138 or email ordernie@tampabay.com. Find us on Facebook at facebook.com/TBTNIE.

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Cover photos: (clockwise from left) Space Shuttle Discovery, NASA; Blue Origin New Shepard, Blue Origin; Skylab, NASA; Astronaut Ed White, NASA; Perseverance Mars Rover, NASA; Sputnik 1, National Air and Space Museum

Florida Standards

This publication and its activities incorporate the following Florida Standards:

BEST: ELA.58.EE.1.1; ELA.58.EE.2.1; ELA.58.EE.3.1; ELA.58.EE.4.1; ELA.58.EE.5.1; ELA.58.EE.6.1; ELA.518.C.1.3; ELA.58.C.1.4; ELA.58.C.1.5; ELA.58.C.2.1; ELA.58.C.3.1; ELA.58.C.4.1; ELA.58.C.5.1; ELA.58.F.1.3; ELA.58.F.1.4; ELA.58.R.2.1; ELA.58.R.2.2; ELA.58.R.2.3; ELA.58.R.2.4; ELA.58.R.3.2; ELA.58.R.3.3; ELA.58.V.1.1; ELA.58.V.1.3 **Math:** MA.7.AR.3.1; MA.6.AR.3.4; MA.7.GR.1.5; MA.58.MTR.2.1; MA.7.NSO.2.2; MA.7.NSO.1.5; MA.6.NSO.4.2 **Science:** SC.5.E.5.3; SC.5.N.1.1; SC.6.N.1.1; SC.6.N.1.5; SC.6.N.2.1 SC.6.N.2.2; SC.6.N.2.3; SC.7.N.1.1; SC.7.N.1.3; SC.7.N.2.1; SC.7.N.3.2; SC.8.E.5.1; SC.8.E.5.2; SC.8.E.5.3; SC.8.E.5.9; SC.8.E.5.10; SC.8.E.5.12; SC.8.N.1.1; SC.8.N.4.2; SC.68.PE.3.1; SC.68.PE.3.2; SC.68.PE.3.3; SC.68.PE.3.4; SC.7.N.3.2 **Social Studies:** SS.5.A.1.1; SS.5.A.1.2; SS.6.E.1.1; SS.6.W.1.1; SS.6.W.1.2; SS.6.W.1.3; SS.7.CG.2.9; SS.7.CG.4.2; SS.7.E.2.4; SS.8.A.1.1; SS.8.A.1.2; SS.8.A.1.3; SS.8.A.1.5; SS.8.A.4.6; SS.8.E.2.1

TEACHERS
download the teacher guide for this publication at nieonline.com/tbtimes/curriculum_science.cfm#space!