icMercury

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Interstellar Ventures: the Past, Present, and Future of Space Exploration

Mar 2024

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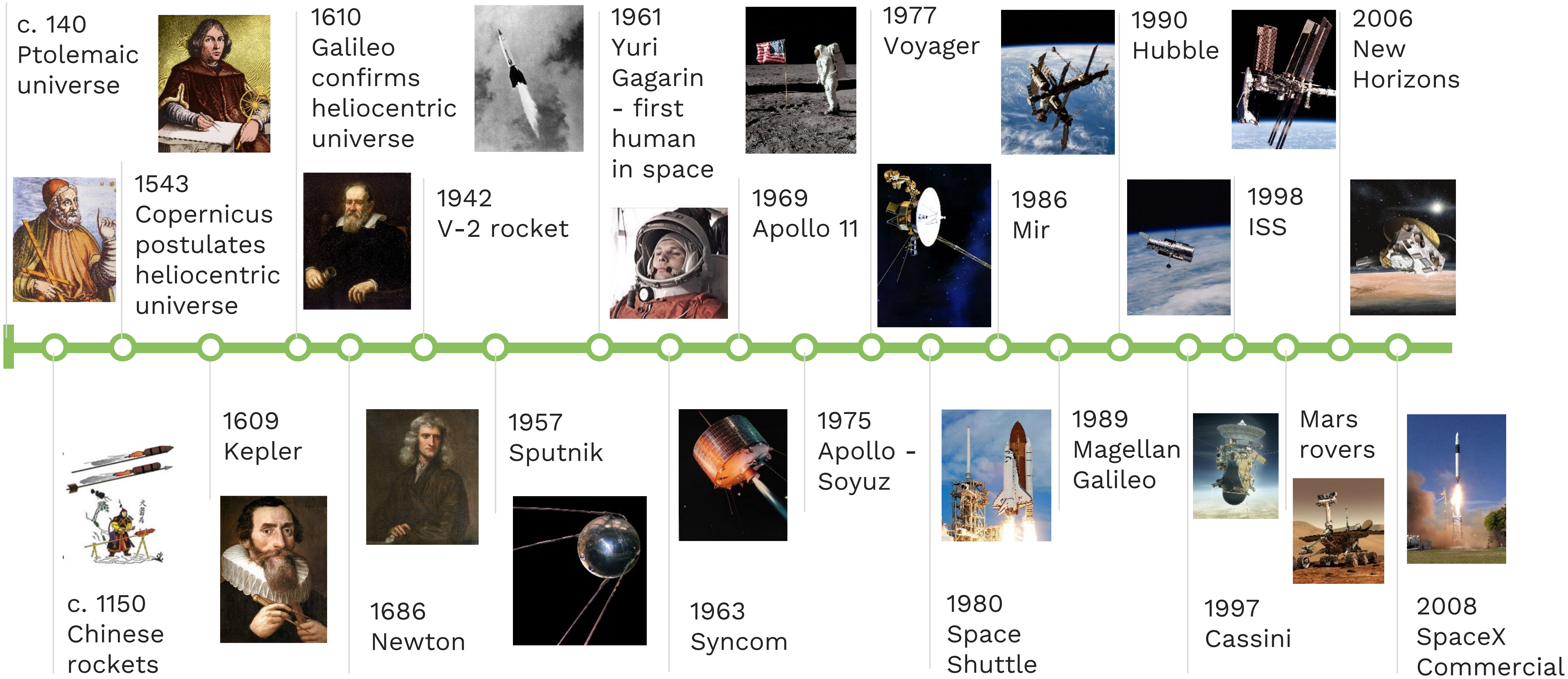
Timeline of Space Exploration



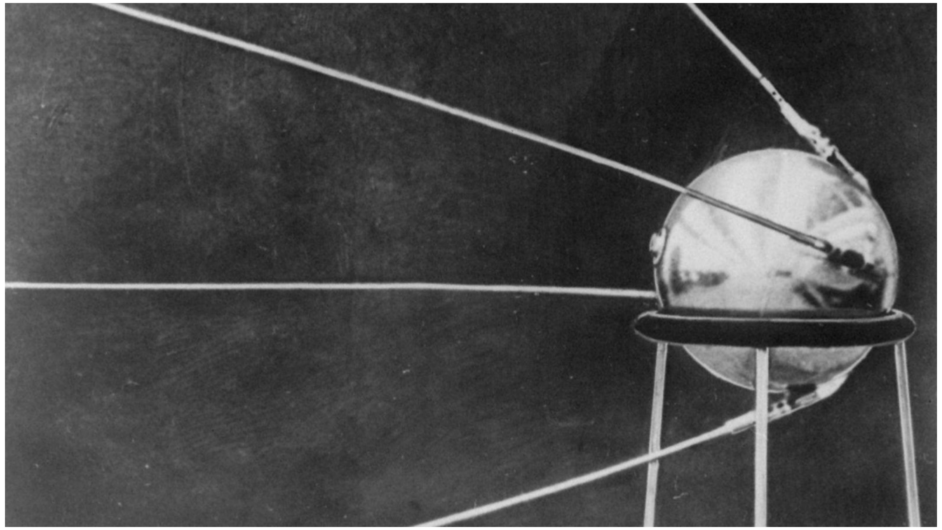
V-2 – The First Vehicle to Touch Space

- The V-2 rocket was developed by Wernher von Braun and his German team during WWII
- Single stage rocket fueled by liquid oxygen and alcohol
  - It was the first ballistic missile and first object to go into the **fringes of space**
  - The first launch occurred on October 3, 1942
  - After the war:
    - Most of the V-2 planning team (including von Braun) chose to surrender to the Americans
    - Much of the V-2 production team was captured by the Russians, setting the stage for the Space Race

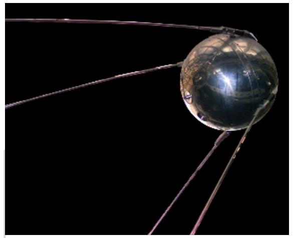
Source: NASA

Sputnik - 1957: The Dawn of Space Age

- Sputnik 1 was the first artificial Earth satellite. It was launched into an elliptical low Earth orbit by the Soviet Union on 4 October 1957.
- The 84 kg sphere ushered in the “Space Age”
- It sent a radio signal back to Earth for 21 days before its three silver-zinc batteries ran out and burned up on reentry on January 4, 1958.
- Its radio signal was easily detectable by amateur radio operators, and the 65° orbital inclination made its flight path cover virtually the entire inhabited Earth.

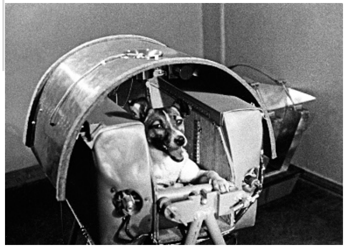


The Space Race: 1957-1969

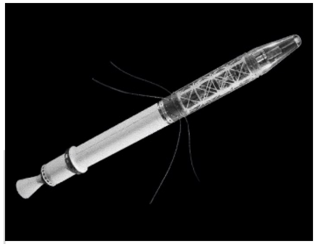


1957
Oct 4
SPUTNIK 1
First satellite in space

1957
Nov 3
Dog Laika
First animal on spacecraft



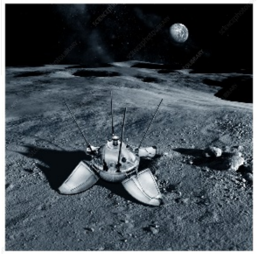
1958
Feb 1
Explorer I
First U.S. satellite

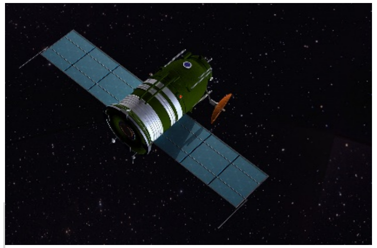


1958
Jul 29
NASA established

1961
Apr 12
Yury Gagarin
First human in orbit

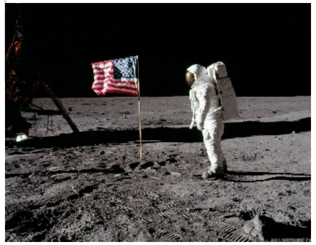
1966
Feb 3
Luna 9
First soft landing on the Moon





1968
Sep 14-21
Zond 5
First spacecraft to fly around the Moon and return to Earth

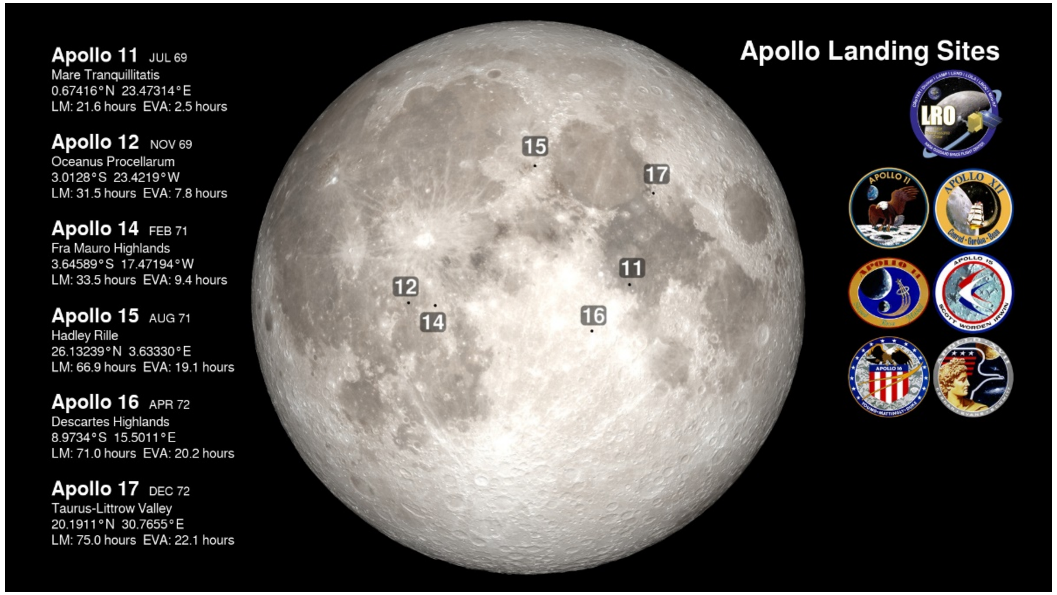
1969
Jul 20
Apollo 11
First humans land on the Moon



Source: Encyclopædia Britannica

Apollo Missions: Moon Landings

- Apollo was a project conducted by NASA in the 1960s and 1970s that landed the first humans on the Moon.
- The Apollo program funding accounted for 48% of the NASA budget from 1962-73, a total of **$19,408,134,000**.
- **Apollo 1**: On January 27, 1967, during testing for launch, fire swept through the command module killing Grissom, White, and Chaffee.
- **Apollo 11**: On July 20, 1969, Armstrong and Aldrin are first two men to set foot on the Moon



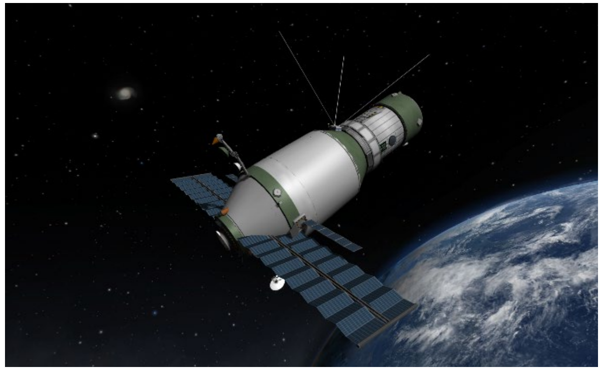
- In all, **12 men** walked on the Moon during the Apollo program. Total of **12 days and 12 hours** spent on the Moon by humans over 6 Apollo missions. Total of **3 days and 18 hours** spent walking on the Moon in **14 moonwalks**.

Space Stations – 1970's thru 1990's

Name	Launched	Reentered	Days in orbit	Days occupied	Total crew and visitors	Mass (* = at launch)	Pressurized volume
Salyut 1	Apr 19, 1971	Oct 11, 1971	175	24	6	18,425 kg (40,620 lb)	100 m^3 (3,500 cu ft)
Skylab	May 14,1973	Jul 11, 1979	2249	171	9	77,088 kg (169,950 lb)	360 m^3 (12,700 cu ft)
Salyut 3	Jun 25,1974	Jan 24, 1975	213	15	2	18,900 kg (41,700 lb)	90 m^3 (3,200 cu ft)
Salyut 4	Dec 26, 1974	Feb 3, 1977	770	92	4	18,900 kg (41,700 lb)	90 m^3 (3,200 cu ft)
Salyut 5	Jun 22, 1976	Aug 8, 1977	412	67	4	19,000 kg (42,000 lb)	100 m^3 (3,500 cu ft)
Salyut 6	Sep 29,1977	Jul 29, 1982	1764	683	33	19,000 kg (42,000 lb)	90 m^3 (3,200 cu ft)
Salyut 7	Apr 19, 1982	Feb 7, 1991	3216	861	22	19,000 kg (42,000 lb)	90 m^3 (3,200 cu ft)
Mir	Feb 19, 1986	Mar 23, 2001	5511	4594	125	129,700 kg (285,900 lb)	350 m^3 (12,400 cu ft)

Space Stations – 1970's thru 1990's continued

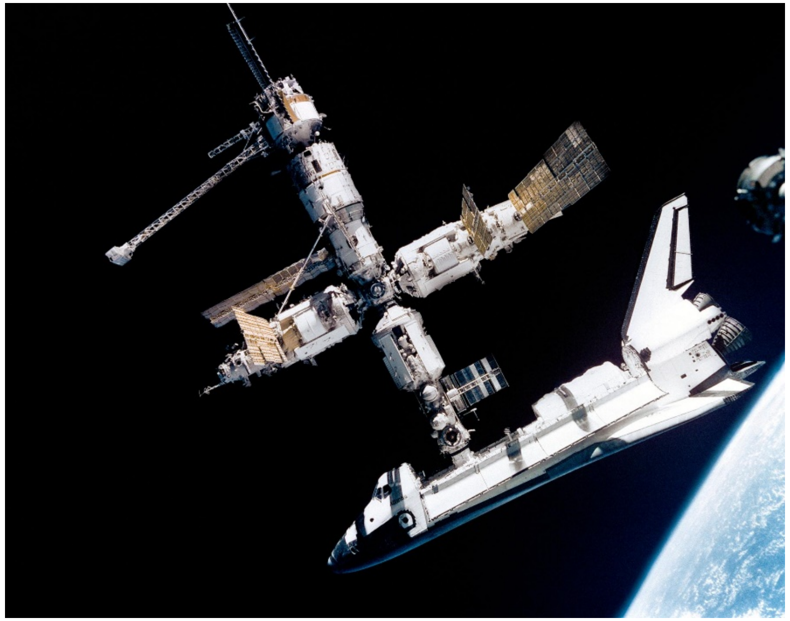
Salyut 1, 1971



Salyut 3, 1975

Skylab, 1973

Salyut 7, 1982



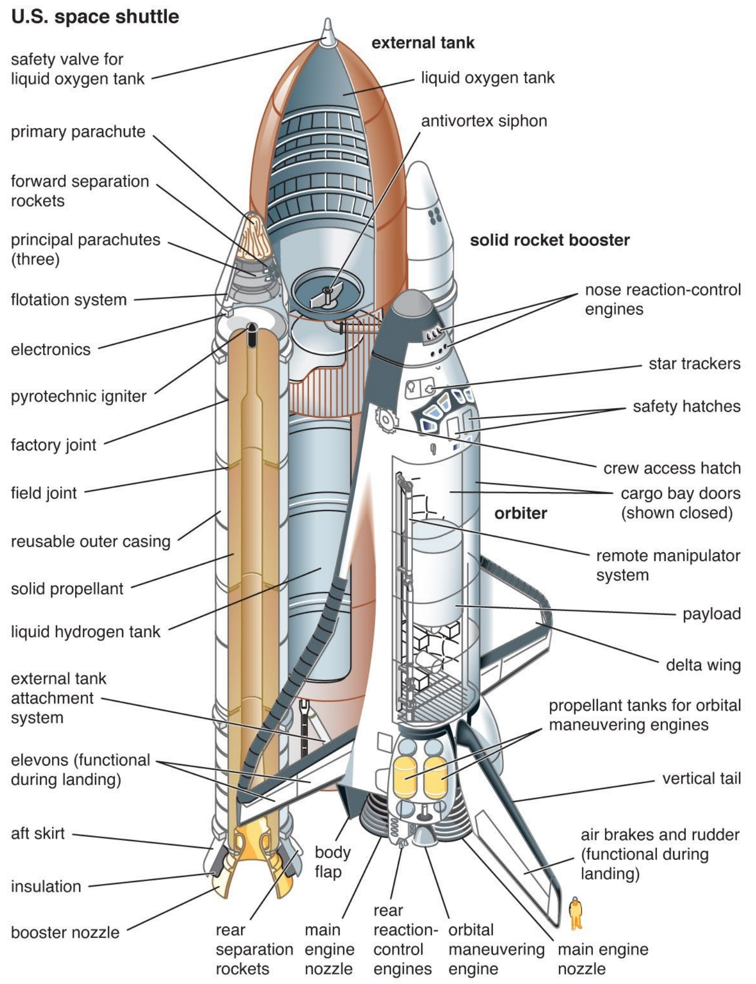
Mir, 1986

The Space Shuttle – 1981-2011

The Space Shuttle was the world's **first reusable spacecraft**, and the first spacecraft in history that can carry large satellites both to and from orbit.

From the first launch on **April 12, 1981** to the final landing on **July 21, 2011**, NASA's space shuttle fleet executed **135 missions**, involving a collective 852 shuttle fliers and accumulating a total mission time of 1,323 days.

Commencing with Columbia and progressing through Challenger, Discovery, Atlantis, and Endeavour, the spacecraft successfully conducted operational missions. These included launching numerous satellites, interplanetary probes, and the **Hubble Space Telescope** (HST), performing science experiments in orbit, collaborating in the Shuttle-Mir program with Russia, and contributing to the construction and servicing of the **International Space Station** (ISS).



Vehicles that Propel Us Beyond

USA		Payload to LEO	First Launch	No. Launches
Light				
ABL Space Systems	RS1	2,980	2023	2
Rocket Lab	Electron	660	2017	38
Firefly Aerospace	Alpha	2,580	2021	2
Medium				
Northrop Grumman	Antares	18,000	2013	18
SpaceX	Falcon 9 block 5	22,800	2018	190
ULA	Atlas V	42,000	2002	97
Heavy				
ULA	Delta IV	64,000	2004	15
ULA	Vulcan Centaur	56,000	2023?	0
SpaceX	Falcon Heavy	141,000	2018	7
SpaceX	Starship	550,000	2023	1
Blue Origin	New Glenn	99,000	2024?	0

Europe		Payload to LEO	First Launch	No. Launches
Light				
Avio	Vega	2,200	2022	22
Heavy				
Arianspace	Ariane 6	47,730	2024?	0

Russia		Payload to LEO	First Launch	No. Launches
Light				
Krunichev	Angara 1.2	3,500	2022	2
Medium				
TsSKB-Progress	Soyuz 2	18,100	2006	162
Heavy				
Krunichev	Angara 5	54,000	2014	3

China		Payload to LEO	First Launch	Launches
Light				
Galactic Energy	Ceres 1	900	2020	7
CALT	Long March 11	1,500	2005	16
Medium				
LandSpace	Zhuque-2	13,000	2022	2
Heavy				
CALT	Long March 8	19,000	2020	2

Japan		Payload to LEO	First Launch	No. Launches
Light				
IHI Aerospace	Epsilon	3,300	2013	6
Medium				
Mitsubishi	HII-A	24,000	2001	46
Mitsubishi	H3	62,400	2023	1

India		Payload to LEO	First Launch	No. Launches
Light				
SSLV		1,100	2022	2
Medium				
ISRO	PSLV	8,400	1993	58
Heavy				
ISRO	LVM-3	18,000	2017	7

Others
Israel, Iran, North Korea, South Korea
77 countries have space agencies - 16 have launch capabilities

Chart Credit: Barry Sine

Six Massive New Rockets Coming Online

	NASA	SpaceX	ULA	Blue Origin	Arianespace	China
	SLS	Starship	Vulcan	New Glenn	Ariane 6	Long March 9
First launch	2023	2023	2024	2024?	2024?	2033?
LEO	154,000	550,000	60,000	99,000	47,730	330,000

Chart Credit: Barry Sine

Cargo Vehicles

Retired	Vehicle	Manufacturer	Capacity (lbs)
ESA	ATV	Aérospatiale	16,900
Japan	HTV	JAXA	13,700
USA	Shuttle	Rockwell	36,000
Operational			
USSR/Russia	Progress	Energia	5,300
USA	Dragon 1/2	SpaceX	7,300
USA	Cygnus	Northrop Grumman	8,300
China	Tianzhou	CAST	16,300
Planned			
USA	Dream Chaser	Sierra Space	12,000
Japan	HTV-X	ISS resupply - first launch 2024	6,000
	HTV-XG	Lunar Gateway resupply	?
USA	Dragon XL	SpaceX	11,000
		Lunar Gateway resupply	

Chart Credit: Barry Sine

Manned Spacecraft

United States			
Retired			**Crew**
Mercury 1959 - 1963		26 missions, 6 manned	1
Gemini 1964 - 1966		13 missions, 11 manned	2
Apollo 1966 - 1975		21 missions, 10 manned - 6 lunar, 3 Skylab and 1 Soyuz docking	3
Shuttle 1981 - 2011		135 missions, all manned - 2 fatal crashes	7
Operational			
SpaceX 2019 - present	Dragon 2	11 missions, 10 manned	
Boeing 2019 - present	Dreamliner	2 unmanned missions, first manned mission in 2024	4
NASA 2014 - present	Orion	2 unmanned missions, first manned mission in 2024	4
Blue Origin 2015 - present	New Shepherd sub-orbital	17 unmanned missions, 6 manned missions	6
Virgin Galactic 2018 - present	Spaceship sub-orbital	63 missions, 7 reached space, 1 fatal crash	
Planned			
Sierra Space 2025? -	Dreamchaser	First cargo version flight planned for early 2024	7
SpaceX 2023 - present	Starship	1 unmanned mission to date - did not achieve orbit	100?

Russia			
Retired			**Crew**
Vostok 1961 - 1963		15 missions, 6 manned	1
Voskhod 1964 - 1965		5 missions, 2 manned	1
Buran 1988 - 1988		1 unmanned mission similar to US space shuttle	10
Operational			
Soyuz 1967 - present		177 missions, 151 manned	3
China			
Operational			
Shenzhou 1999 - Present	Shenzhou	15 missions, 11 manned	3
India			
Planned			
Gaganyaan 2024 - present	Gaganyaan	2 unmanned missions planned for 2024, first manned mission in 2025	3

Chart Credit: Barry Sine

Launch Types – Orbital vs Suborbital Launch

Orbital Launch

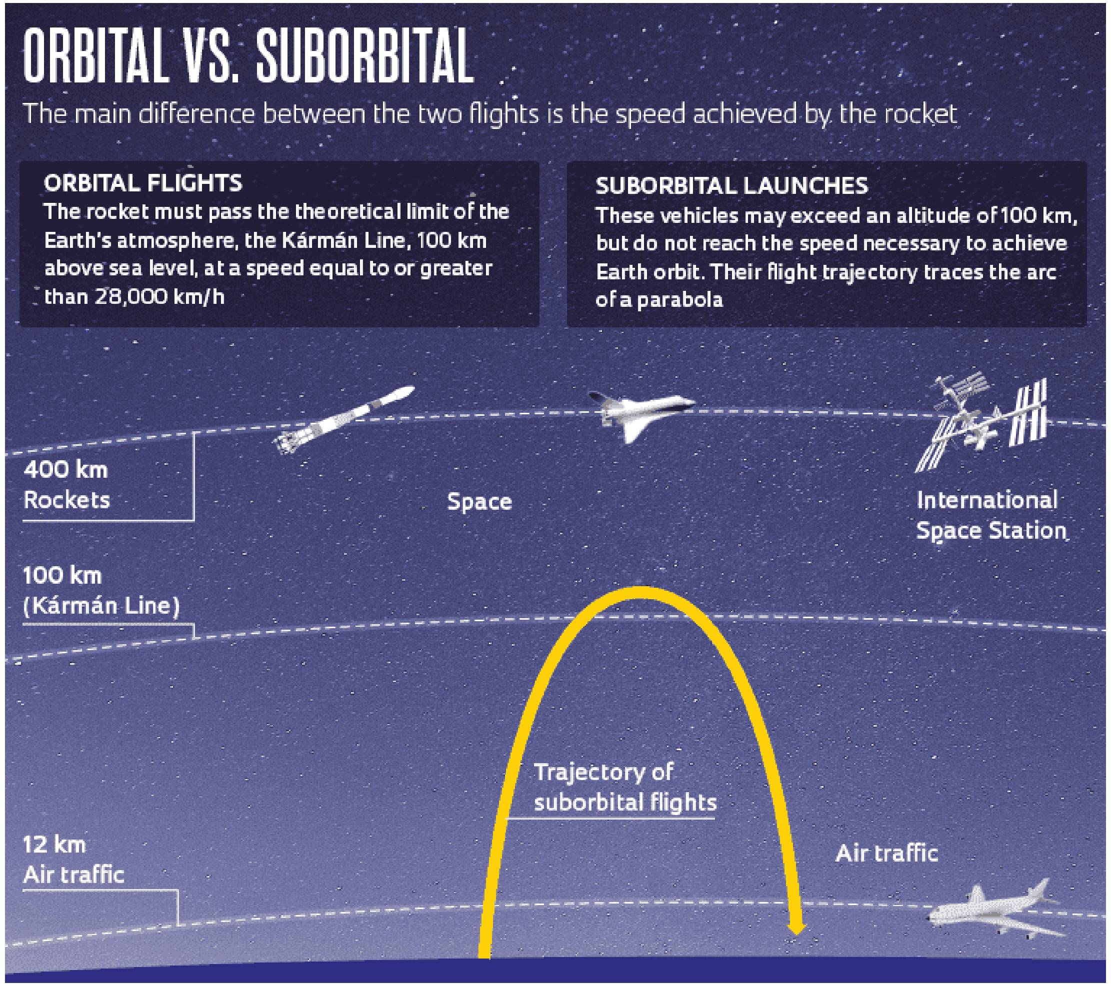
Purpose: To place payloads, such as satellites or spacecraft, into orbit around a celestial body, typically Earth.

Characteristics: Requires achieving sufficient velocity to counteract gravity and enter stable orbit.

Suborbital Launch

Purpose: To reach the edge of space without achieving the velocity necessary for orbital insertion.

Characteristics: Parabolic trajectory, with the spacecraft briefly entering space before returning to Earth.



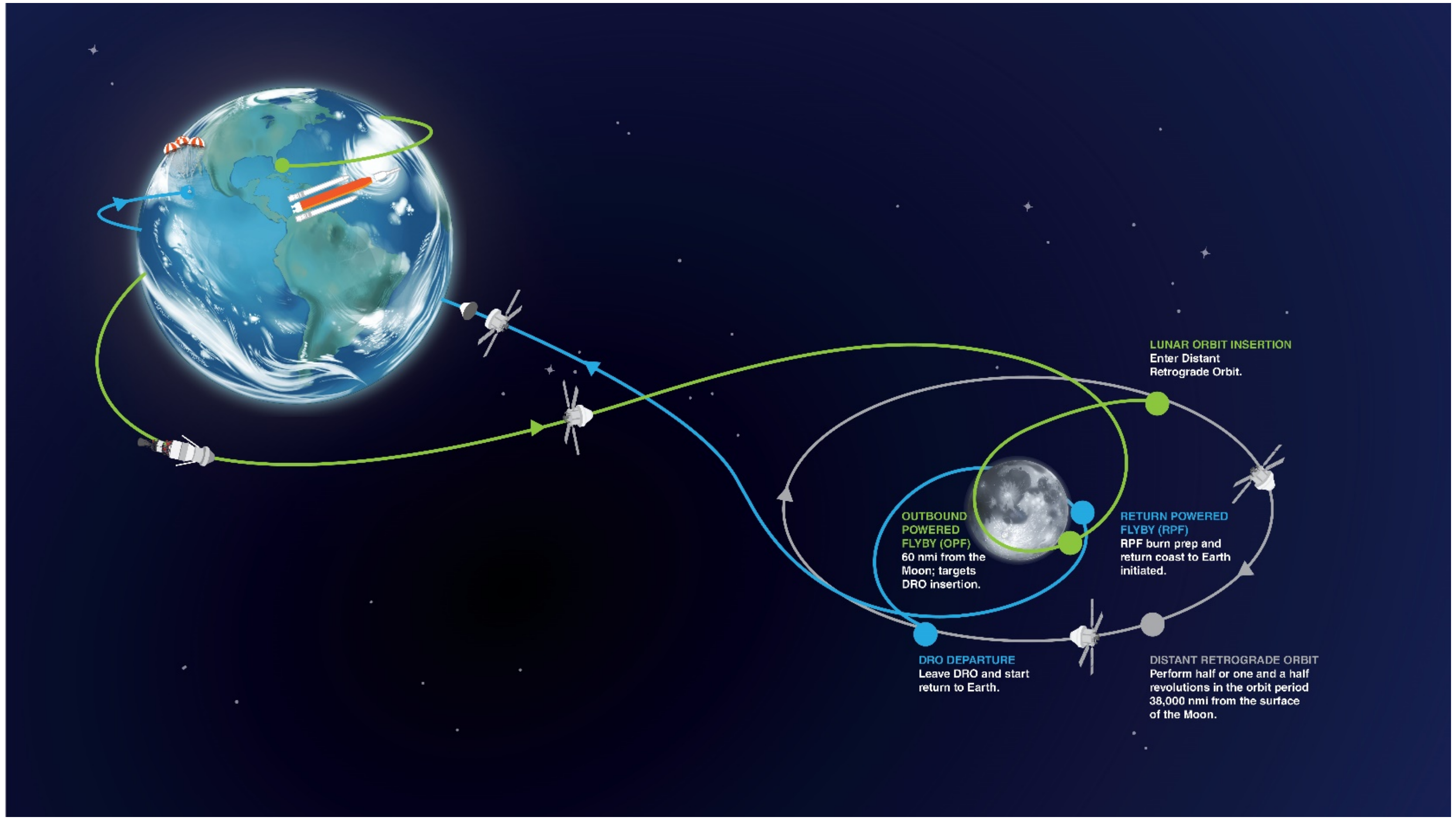
Source: Alexandre Affonso

Launch Types - Escape Trajectory Launch

Escape Trajectory Launch

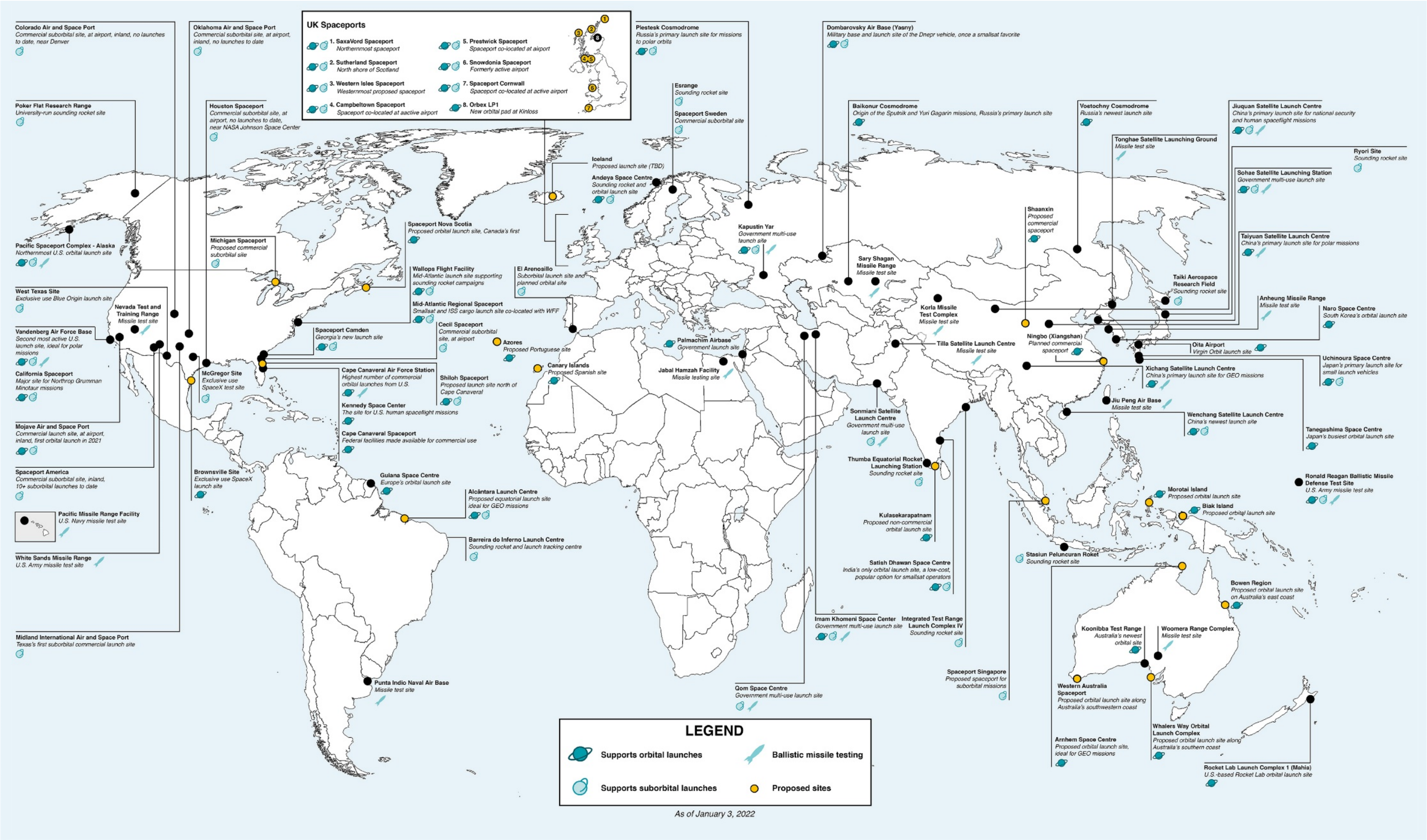
Purpose: To propel spacecraft out of the gravitational influence of a celestial body, such as Earth, towards interplanetary space.

Characteristics: Achieves the necessary velocity to escape the gravitational pull of the originating body.



Source: NASA

Orbital and Suborbital Launch Sites of the World



Source: Bryce Tech

Two Space Stations in Orbit, 8 More Are Planned

Retired					**Planned**		**8 announced - 6 LEO, 2 lunar**
Salyut 1- 7	Soviet Union	1971	-	1991	Orbital Reef	USA $130 million in NASA funding	Blue Origin, Boeing, Sierra and Redwire
MIR	Soviet Union	1986	-	2001	Starlab	USA/Europe $160 million in NASA funding	Voyager, Airbus, Nanoracks, and Lockheed Martin
Skylab	United States	1973	-	1979	Northrop Grumman	USA	Northrop, Dynetics and Rhodium.
Tiangong 1	China	2011	-	2018	Axiom	USA	starting in 2025, plan to adds modules to ISS and then detach already launching human missions via SpaceX
Currently On Orbit		**2 on orbit now**			Haven - 1	USA	Vast purchased Falcon 9 launch for 2025
ISS	US/Russia/Japan/ Europe/Canada	1998	-	2030	Lunar Gateway	USA/Europe Japan/Canada	lunar Halo orbit first launch planned 2025 via Falcon Heavy
					Ross	Russia	2027 planned ISS replacement starting with some newer ISS modules
Tiangong 2	China	2021	-	Present			
					LOS	Russia	After 2030, lunar station planned

Chart Credit: Barry Sine

Space Stations – ISS & Tiangong

- ISS continuously occupied since 2000
  - Expedition 70 Crew of seven onboard
  - Thousands of scientific experiments/publications
- Decommissioning in 2030

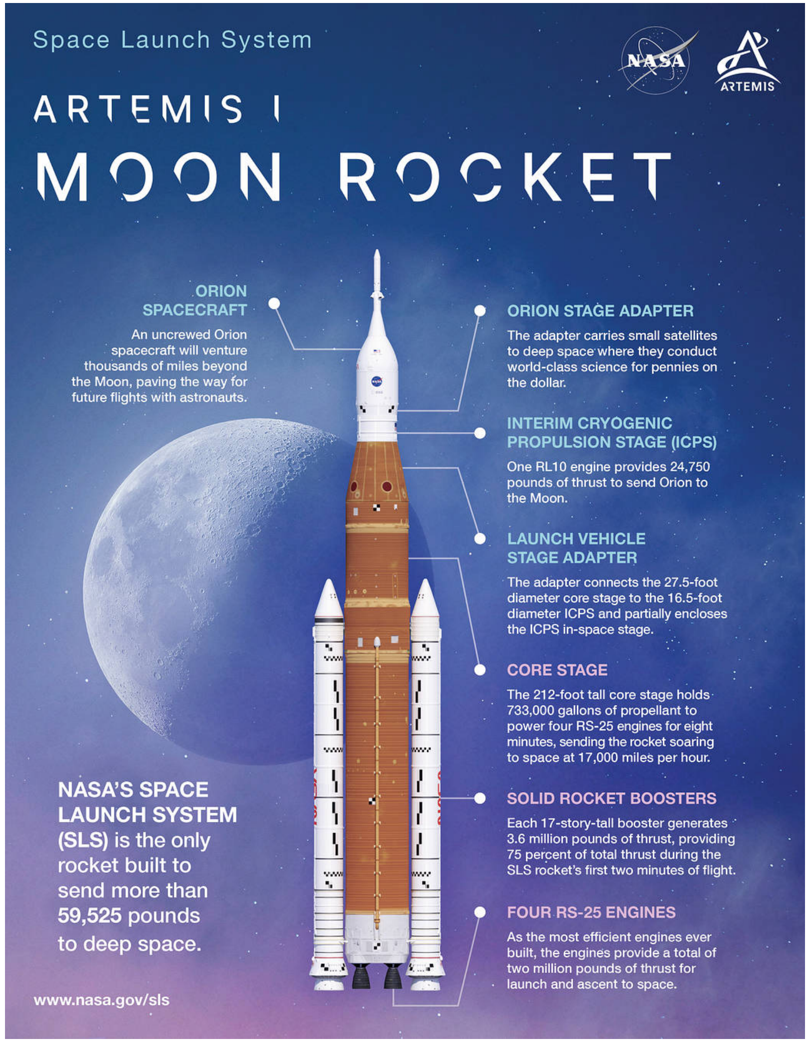
- Tiangong Space Station
  - Assembly began April 2021
  - Currently three modules – will be expanded to six starting in 2027
  - Facilities for biological, physical, material science
  - Shenzhou-17 crew of three now onboard

The Artemis Program – Return to the Moon

The Artemis program is a Moon exploration program that is led by the United States' NASA and was formally established in **2017** via **Space Policy Directive 1**. The Artemis program is intended to reestablish a human presence on the Moon for the first time since Apollo 17 in 1972. The program's stated long-term goal is to **establish a permanent base on the Moon** to facilitate human missions to Mars.

The Artemis Program – Space Launch System

The Artemis program is organized around a series of **Space Launch System (SLS)** missions. These space missions will increase in complexity and are scheduled to occur at intervals of a year or more. NASA and its partners have planned Artemis 1 through Artemis 5 missions; later Artemis missions have also been proposed. Each SLS mission centers on **the launch of an SLS launch vehicle carrying an Orion spacecraft**. Missions after Artemis 2 will depend on support missions launched by other organizations and spacecraft for support functions.



The Artemis Program – The Missions

Artemis I *Launched: Nov. 16, 2022*

- Flyby mission to the moon and back
- Will certify the Space Launch System, the world's most powerful rocket
- Carries no astronauts
- The Orion spaceship section carries test manikins instead of astronauts

Artemis II *Launch target: 2024*

- Crewed mission with four astronauts in the Orion spacecraft
- Will orbit the moon and return

Artemis III *Launch target: 2025*

- Will land astronauts on the moon
- Will use the SpaceX Starship Human Landing System to ferry astronauts and payload from lunar orbit to the Moon's surface and back

Artemis IV *Launch target: 2027*

- No lunar landing
- Will deliver the I-Hab (International Habitation Module) for the planned Gateway space station in lunar orbit; the I-Hab will provide a living and work space for astronauts in the station, and will be built by the European Space Agency and the Japan Aerospace Exploration Agency

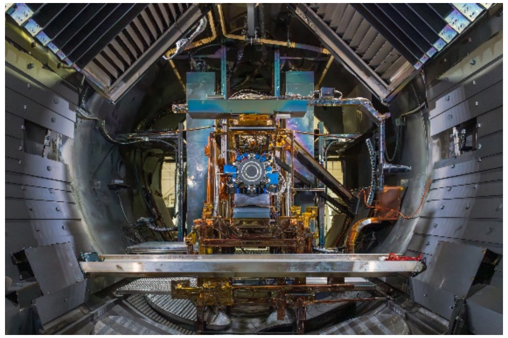
Artemis V *Launch target: 2028*

- Will land astronauts on the moon
- Will deliver the Lunar Terrain Vehicle, allowing astronauts to drive on the lunar surface
- Will rendezvous with the Gateway space station orbiting the moon, adding at least one module to the station

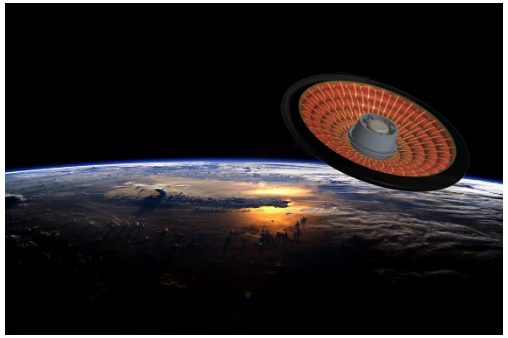
Source: NASA, RANE

Humans to Mars

NASA is advancing many technologies to send astronauts to Mars as early as the 2030s. Here are six things scientists are working on right now to make future human missions to the Red Planet possible.



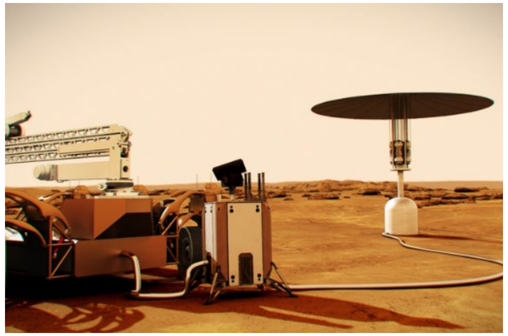
Advanced Propulsion Systems



Inflatable Landing Gear

High-tech Spacesuits

A Home and Lab on Wheels



Surface Power Systems

Laser Communications

Source: NASA

Future Trends in Space Exploration - ISAM

Robots are revolutionizing space by enabling tasks such as extending satellite lifespans, assembling telescopes, and servicing spacecraft, with a focus on foundational capabilities like **In-Space Servicing, Assembly, and Manufacturing (ISAM)**.

Assembly

- Brings together separate parts in space to create functional structures.
- Overcomes rocket fairing volume limitations, enabling construction of large telescopes and habitats.

Servicing

- Extends satellite lifespan through refueling, repair, and upgrades.
- Ends the era of one-and-done spacecraft, enabling adaptability to evolving technology

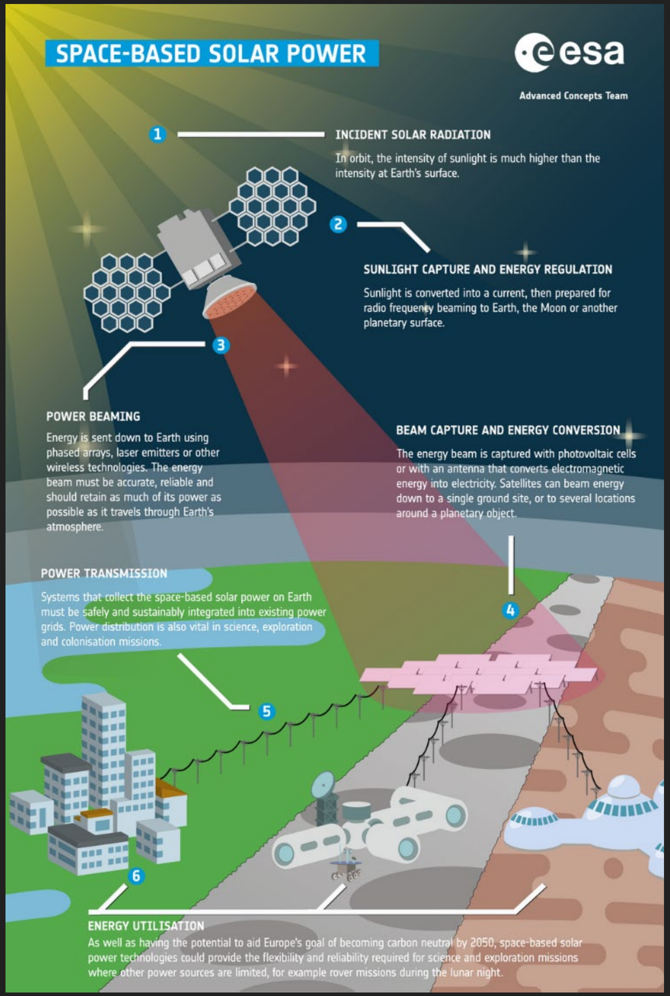
Manufacturing

- Fabricates components in space as needed, increasing adaptability.
- Reduces reliance on launching contingency components and allows for the production of large, jointless structures.
- Enables on-orbit coating applications and nano-manufacturing for optical and thermal property recovery.

Source: https://www.nasa.gov/nexis/isam/

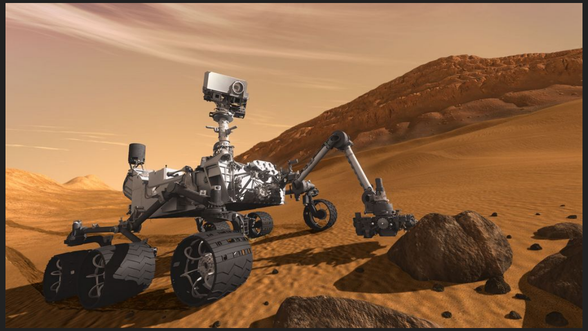
Future Trends in Space Exploration - Space Based Solar Power

Space-based solar power holds immense promise for sustainable energy solutions. With sunlight being over **ten times more intense** at the top of the atmosphere compared to the Earth's surface, harnessing solar energy in space presents an unparalleled opportunity. By deploying collection systems in high orbits where **sunlight is continuously available**, space-based solar power systems could **capture and transmit solar energy wirelessly to receiving stations on Earth**. This innovative approach not only offers a reliable and abundant source of energy but also has the potential to **supplement terrestrial power transmission infrastructure**, particularly in remote areas, thus paving the way for a greener and more sustainable future.



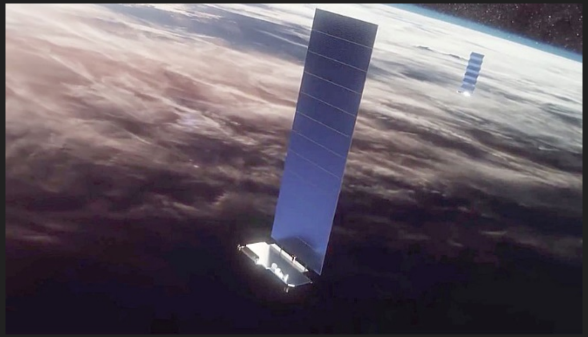
Source: https://www.nasa.gov/organizations/otps/space-based-solar-power-report/

Future Trends in Space Exploration – Technological Evolution



Autonomous Rovers

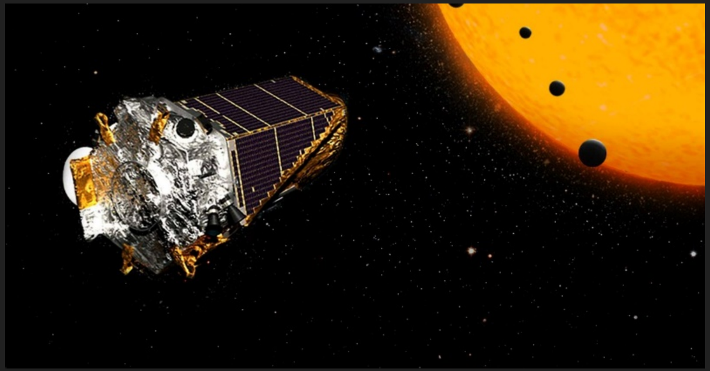
- AI-driven autonomous navigation enables rovers like NASA's Curiosity and Perseverance to safely traverse Martian terrain.
- Sensors detect hazards, while AI analyzes data to determine optimal paths.
- NASA's Perseverance utilizes AI software, AEGIS, to gather data on Martian features, enhancing our understanding of the planet's composition.



Satellite Operations

- AI facilitates efficient satellite operations, including collision avoidance.
- SpaceX's Starlink satellites utilize AI for real-time detection of orbital hazards and adaptive maneuvering to ensure safe navigation.

Future Trends in Space Exploration - Technological Evolution II



Data Analysis

- AI algorithms enhance data analysis from space missions, enabling precise identification, classification, and predictive analysis.
- Machine learning models identify patterns, classify celestial objects, and detect anomalies, accelerating our understanding of the universe.

Rocket Landing

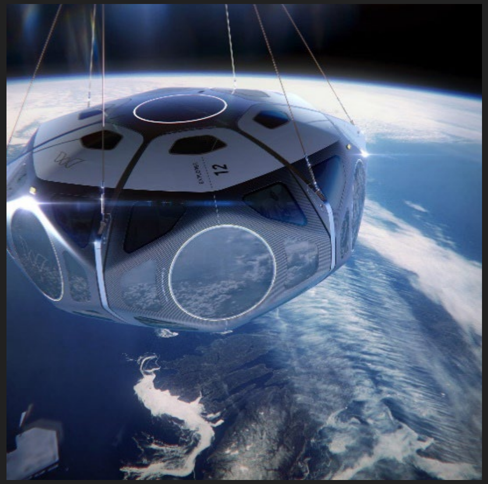
- AI integration improves rocket landing precision.
- SpaceX employs AI systems to analyze sensor data and adjust trajectory in real-time, ensuring optimal landing positioning.

Galaxy Mapping

- AI enables precise star and galaxy mapping, enhancing astronomers' understanding of celestial bodies.
- NASA's Kepler telescope uses AI to detect planet candidates through subtle light fluctuations, aiding in future exploration missions and understanding galactic behavior over time.

Future Trends in Space Exploration - Suborbital Space Tourism

Suborbital space tourism has become an increasingly captivating prospect, providing an accessible and thrilling opportunity for individuals to venture beyond Earth's atmosphere and experience the wonders of space firsthand.



High Altitude Balloons

- World View (US)
- Zephalto (FR)
- Space Perspective (US)

Suborbital Flights

- Blue Origin (US)
- Virgin Galactic (US)

Point-to-Point Suborbital Transportation

- Space Transportation (CN)
- SpaceX (US)

How Normal People Can Explore and Enjoy Space I

Stargazing

Connect with local astronomy clubs, planetariums, or observatories for opportunities to observe celestial wonders.

Citizen Science Projects

Engage in scientific research by contributing to projects like Galaxy Zoo or NASA's Globe Observer.

How Normal People Can Explore and Enjoy Space II

Send your DNA to the Moon

Participate in a space-time capsule program to immortalize your DNA on the lunar surface.

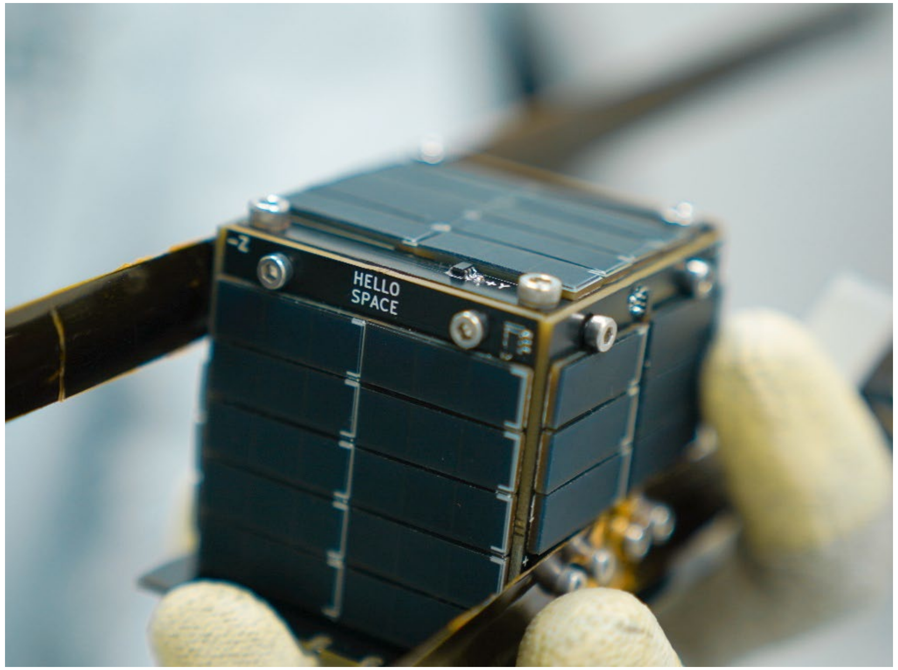
Beam a song to space

Transmit your favorite music to orbit the Earth aboard the International Space Station, creating a unique connection with space.

How Normal People Can Explore and Enjoy Space III

Space tour

Embark on an unforgettable space travel experience by booking a space tour.



Own a personal satellite

Launch a PocketQube satellite into space, gaining access to your very own piece of the cosmos.


"Keep Looking Up" was my life's admonition,
I can do little else in my present position.
--Jack Horkheimer

THANK YOU

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Interstellar Communication Holdings Inc.

4201 Collins Ave. Suite 402, Miami Beach, FL 33140 USA

Earth, Solar System, Milky Way, Laniakea

The Pale Blue Dot is a photograph of Earth taken Feb. 14, 1990, by NASA’s Voyager 1 at a distance of 3.7 billion miles (6 billion kilometers) from the Sun.