

The exploration of space has been a dream of mankind since humans started to walk the Earth.



The 2nd World War saw the development of flying bombs. The first missiles...

German V1 and V2 rockets:



After the end of the war German scientists went to take up jobs in the United States of America. Other German scientists went to work at locations in the Soviet Union.

Missile and Nuclear technology was developed in the United States and Russia, the two new world powers. To a lesser extent research and development was also happening in the United Kingdom of Great Britain and Northern Ireland and in other nations.

Sputnik1 (image below) was the first satellite in of a series of Sputnik artificial satellites. Sputnik 1 was launched on 4 October 1957 and placed in orbit by the Soviet Union. Many years later Soviet Union evolved joining the free market economy as the Russian Federation.

This launch put Russia ahead of the game and caused the United States to allocate more resources to the exploration of space.





In 1958 The United States set-up NASA. ... National Aeronautics and Space Administration. NASA's predecessor agency, the National Advisory Committee for Aeronautics (NACA) was created in 1915. The space agency was one of seven Centennial organisations whose longevity was studied in a recent report.

John Fitzgerald Kennedy (May 1917 – November 22, 1963), often referred to by the initials **JFK**, served as the 35th president of the United States from January 1961 until his assassination in November 1963.

Nikita Sergeyeovich Khrushchev (April 1894 – September 11 1971) led the Soviet Union from 1958 to 1964

This was during a period of Geo-political tensions known as the Cold War. The Cold War existed between the world powers 1947 to 1991.

Yuri Alekseyevich Gagarin (March 1934 – March 1968) was a Soviet Air Forces pilot and cosmonaut. He became the first human to journey into outer space, achieving a major milestone in the Space Race; his capsule Vostok 1 completed one orbit of Earth on 12 April 1961.



Russia had taken the lead in manned space flight.

In 1961 Alan Bartlett Shepard Jr. (November 1923 – July 1998) became the first American to travel into space, and in 1971 he walked on the Moon.



In June 1961 JFK had declared to the world "**Together let us explore the stars**".

When he met with Nikita Khrushchev, the Premier of the Soviet Union.

Kennedy proposed making the Moon landing a joint project, but Khrushchev did not take up the offer.

The Nation's Space Effort –12 September 1962

(Extract from a speech made by John F. Kennedy at Rice University in the United States)

There is no strife, no prejudice, no national conflict in outer space as yet. Its hazards are hostile to us all. Its conquest deserves the best of all mankind, and its opportunity for peaceful cooperation may never come again. But why, some say, the moon? Why choose this as our goal? And they may well ask why climb the highest mountain? Why, 35 years ago, fly the Atlantic? Why does Rice play Texas?

We choose to go to the moon. We choose to go to the moon in this decade and do the other things, not because they are easy, but because they are hard, because that goal will serve to organize and measure the best of our energies and skills, because that challenge is one that we are willing to accept, one we are unwilling to postpone, and one which we intend to win, and the others, too.

It is for these reasons that I regard the decision last year to shift our efforts in space from low to high gear as among the most important decisions that will be made during my incumbency in the office of the Presidency.

In the last 24 hours we have seen facilities now being created for the greatest and most complex exploration in man's history. We have felt the ground shake and the air shattered by the testing of a Saturn C-1 booster rocket, many times as powerful as the Atlas which launched John Glenn, generating power equivalent to 10,000 automobiles with their accelerators on the floor. We have seen the site where five F-1 rocket engines, each one as powerful as all eight engines of the Saturn combined, will be clustered together to make the advanced Saturn missile, assembled in a new building to be built at Cape Canaveral as tall as a 48 story structure, as wide as a city block, and as long as two lengths of this field.



Dr. Wernher von Braun (1912–1977) was one of the most important rocket developers and champions of space exploration in the twentieth century.

At the National Aeronautics and Space Administration (NASA). The primary objective was to develop giant Saturn rockets. Accordingly, von Braun became director of NASA's Marshall Space Flight Centre and the chief architect of the Saturn V launch vehicle, the super booster rocket that would propel Americans to the Moon.

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Sergei Pavlovich Korolev (left) born in the Ukraine was a lead Soviet rocket engineer and spacecraft designer during the Space Race between the United States and the Soviet Union in the 1950s and 1960s. Korolev directed the Soviet Space Program and oversaw the development of the N1 Rocket launch vehicle (left). A powerful rocket intended to enable crewed travel to the Moon and beyond. Korolev died in 1966 and as a result the project derailed.

At the National Aeronautics and Space Administration (NASA). The primary objective was to develop giant Saturn rockets, Dr. Wernher von Braun, a former German rocket scientist became director of NASA's Marshall Space Flight Centre and was the chief architect of the Saturn V launch vehicle, the super booster rocket designed and built to propel Americans to the Moon.

The design of the Saturn rockets probably changed a little over time. The photo (below) is one of the early versions on display at the JFK Space Centre in Florida in the United States.



The Apollo Program spanned the years from 1963 to 1972

Apollo 7 was the first crewed flight
Launched 11 October 1968

Apollo 8 (unmanned)
Launched 21 December 1968
Lunar Orbit and Return
Returned to Earth 27 December 1968

Apollo 9
Launched 03 March 1969
First crewed Lunar Module test
Splashdown 13 March 1969

Apollo 10 (unmanned)
Launched 18 May 1969
Lunar Orbit and Return
Returned to Earth 26 May 1969



Saturn 5 rockets were used by NASA to launch the Apollo missions designed under the direction of Wernher von Braun at the Marshall Space Flight Centre in Huntsville, Alabama.

Boeing, North American Aviation, the Douglas Aircraft Company, and IBM were the lead contractors.



Earth Rise a photo taken during the Apollo 8 Lunar Orbit and Return.

The First Lunar Landing of Mankind was successfully achieved on 20th July 1969 by a team of three Astronauts **Neil Armstrong, Buzz Aldrin and Michael Collins**; this was the Apollo 11 Mission.

It's a little over eight years since the flights of Gagarin and Shepard, followed quickly by President Kennedy's challenge to put a man on the moon before the decade is out.

This bold “land a man on the Moon” endeavour was not achieved without cost, not only in Dollar values but in terms of the loss of human lives. People’s lives are valuable human resources.



The crew of Apollo 1 (photo. left) Grissom, White and Chaffe lost their lives in a cabin fire during a launch test in February 1967

The cockpit fire almost resulted in the whole programme being cancelled. Manned Apollo flights were suspended for 20 months while hazard problems in the command module were resolved.

“Whenever Mankind has sought to conquer new frontiers there have been those who have given their lives for the cause”

... A quote from the Astronauts Memorial Foundation.



The Parkes Observatory radio telescope, in New South Wales, Australia was used by NASA to receive signals from the Apollo craft, along with the NASA Honeysuckle Creek Tracking Station near Canberra in ACT (Australian Capital Territory).

In the days before the July 1969 space mission, NASA was working with a group of Australian technicians who had agreed to engineer a space-to-Earth interface to carry the video and telemetry signals from the Lunar Lander on the Moon and relay them to the global audience. The radio telescope dish had to be large, as the signals expected from the spacecraft were very weak and easily lost. Due to its position in the Southern Hemisphere NASA had to use the Parkes radio telescope. The Parkes Radio Telescope is located near to Parkes in New South Wales, Australia and is in the middle of an Australian sheep farm. A film called “The Dish” was made in 2000 that tells the somewhat fictionalised story of how the Parkes Radio Telescope relayed live television on the first steps on the Moon during the Apollo 11 mission.

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Australia is involved with the development of radio telescopes and is a partner in the Square Kilometre Array (**the SKA**) an inter-governmental radio telescope project to be built in part in Australia and in the Republic of South Africa. The headquarters of the project are located at the Jodrell Bank Observatory, in the United Kingdom of Great Britain and Northern Ireland. The Square Kilometre Array Observatory Organisation (SKAO) was founded in Rome by seven initial member countries, several other countries are expected to join in this endeavour. The Square Kilometre Array (SKA) is a global big-science project to build the world's largest and most capable radio telescope. During its more than 50 year lifetime, the SKA will expand our understanding of the universe and drive technological developments world-wide. The project is in the pre-construction phase.

The SKA aims to answer some of the biggest questions in astronomy. Its sensitivity, resolution and scanning speed will enable scientific discoveries in key areas and answer some key questions

The SKA a part of in the Western Australia desert and the other part in the Republic of South Africa.



The Jodrell Bank Observatory is in Cheshire in the United Kingdom.

The Lovell Telescope at Jodrell Bank was commissioned in 1957 and played a role in the observation of the Sputnik satellite and tracked the Moon missions.

The telescope was named after Sir Bernard Lovell the director of the observatory. The Jodrell Bank Centre for Astrophysics at the University of Manchester, is among the largest astrophysics groups in the United Kingdom.



The First Lunar Landing of Mankind was successfully achieved on 20th July 1969 by a team of three Astronauts. It's a little over eight years since President Kennedy's challenge to put a man on the moon before the decade is out.

Newspapers around the world reported on the achievement.

The Des Moines Register
The Newspaper Iowa Depends Upon
 Des Moines, Iowa, Monday Morning, July 21, 1969—22 Pages—Two Sections Price 10 Cents

MAN WALKS ON MOON!

Spaceship Lands First Yanks

THE WORLD'S FIRST MOON MEN

Neil A. Armstrong

Edwin E. (Buzz) Aldrin, jr.

Michael Collins

'Fantastic' Trip By Armstrong And Aldrin

HOUSTON, TEX. (AP) — Man came to the moon and walked its dead surface Sunday, July 21, 1969.

Two men, wearing American flags sewn to their left shoulders, landed on the sea of Tranquillity at 9:57 p.m. (Iowa time). One of them, Neil A. Armstrong, 38, of Wapakoneta, Ohio, was the first to set foot on its alien soil wearing in the lunar suit.

His first words at that moment, 9:58 p.m. were: "That's one small step for man, one giant leap for mankind."

"The surface is fine and powdered, like powdered charcoal in the color of my feet ... I can see my footprints of my feet in the fine particles."

He was joined by Edwin E. Aldrin, Jr. in Armstrong stepped first onto one of the four ocean-like footpads of the spacecraft. Then the moon. He was in the lunar suit of lunar chambers in the vacuum except the sight of the left foot, the right, putting into the lunar soil.

Armstrong told the spacecraft's telecasts that ground under his feet on the lunar soil. He had used only a "hand hammer—about an eighth of an inch" size, he said.

The first steps were cautious in the new lunar gravity of the moon. He is quickly reported: "There is no trouble to walk around."

Armstrong was not visible in the third Apollo 11 spacecraft, Air Force Lt. Col. Michael Collins looked in a lunar parabolic orbit in the command ship Columbia, some 60 miles above Earth.

"I had a small headache all day," Armstrong said. "It's different, but it's very gentle and less."

The television camera on the side of the Eagle was in line constantly.

Plenty of Room

When first Armstrong emerged from the spacecraft, slowly, cautiously, looking out, the world waited, and waited. Its first reported observation from Aldrin. "Plenty of room in your suit."

"How are I doing?" he asked. "That's doing fine," he was answered. "They're just making contact. Okay, I'm on the ground." It was 10:02 p.m.

After he pressed the television camera, the picture of his face emerging, tentatively groping for the ladder rungs, could be seen clearly.

Minutes later as he searched the surface for rocks and soil samples to be returned to Earth, the sunlight, his white suit glinting.

His movements were not of grace, observed legs about like a slow-motion kangaroo. Suddenly he returned to the spacecraft to perform his lunar duties.

Armstrong and Aldrin had been instructed to be well-organized, carefully planned. They asked, and received permission, to make their work early.

Awaiting Reunion

Single landed on the moon while Collins — in the mother ship that brought them — continued to orbit the moon awaiting their reunion 24 hours later.

"Houston," Armstrong's radio called up in the first lunar communication from the moon. He pressed a call sign around. "Tranquillity base here. The Eagle has landed."

"Houston," said Collins on the lunar radio about seven minutes later.

Later Collins sent a message "ask major person looking elsewhere that may be in position for a rendezvous and interception of the command of the good two hours and to give Aldrin in the air or on the way."

The moon had brought them here were already prepared, and the lunar station.

By Eagle toward the surface of the moon, Armstrong saw that the communication antenna pilot was heading the Eagle ship toward a dark mountain with craters and landings in the projected landing site on the moon's Sea of Tranquillity.

Grabbed Control of Ship

He grabbed control of the ship, took it clear of the area where it would have run almost certain crash, and landed her close toward the original landing point.

It was a nearly momentous 20 in the available fuel short. When it landed Eagle had barely 30 seconds worth of landing rocket fuel left, less than half of the 120 seconds worth it was supposed to have.

The landing on the moon was the climax of a national quest declared by the late President John F. Kennedy, the fulfillment of his dream.

"The moon landing was going on right into a ball of fire," Armstrong said. "It's required us to fly constantly over the moon 24 hours a day in a non-stop orbit."

They landed just north of the moon's equator. In the original landing site, Armstrong said, there were "extremely smooth."

First Words as Man Stands on Moon

'That's One Small Step for Man, One Giant Leap for Mankind'

Site of Man's Historic Landing

Arrow locates the approximate landing site of the Apollo 11 lunar module as it touched down on the moon at 9:57 p.m. Sunday in a perfect landing.

The site was the first chosen for a moon landing, located in the smooth area on the western edge of the Sea of Tranquillity. Page of Saturday, Page 2.

MORE MOON STORIES

World Erupts In Cheers

NEIL'S MOTHER: 'PRAISE GOD'

EXCERPTS from Armstrong's report after landing on moon — Page 1

ARMSTRONG walked 200 feet on the moon before 200 Page 2

ARMSTRONG said Collins (page 1) was "in a very good position" to see the moon's surface. Page 3

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Moon Holiday: No Mail Today

There will be no mail in Iowa today as the state observes the moon landing anniversary. The Post-Des Moines office will be closed today in honor of the lunar landing of Apollo 11. All governmental state offices will be closed today in honor of the moon landing anniversary.

Neil Armstrong and Edwin (Buzz) Aldrin walked on the Moon.

The historic date of the first lunar landing was July 20 1969

The “put a man on the moon endeavour” involved a lot of team work; mission controllers, planners, the engineers who: conceived, designed, built and tested the craft, instruments and equipment. It was not just NASA employees who made the Moon landings happen, the bold endeavour also involved a lot of companies in the private sector.

The main private sector contributors were:

- Northrop Grumman.
- Pratt and Whitney.
- Aerojet Rocketdyne.
- General Motors.
- Beechcraft.
- Motorola.
- Hammond Organ.
- Honeywell.

Apollo didn't just advance technology it advanced the way business was done. For example Boeing later developed the 747 Aircraft applying similar methodologies.

After this the Apollo program continued and with the exception of Apollo 13 with more Moon landings, together with the collection scientific data and samples. After a time the interest of the public declined resulting in the US government ending the funding for the Apollo Program.

The Apollo missions that followed the Moon landing were:

Apollo 12

Launched 14 November 1969
Landed on Moon 19 November 1969
Ocean of Storms
Returned to Earth 24 November 1969

Apollo 13

Launched 11 April 1970
Lunar Flyby and Return
A malfunction forced cancellation of lunar landing
Returned to Earth 17 April 1970

Apollo 14

Launched 31 January 1971
Landed on Moon 5 February 1971
Fra Mauro
Returned to Earth 9 February 1971

Apollo 15

Launched 26 July 1971
Landed on Moon 30 July 1971
Hadley Rille
Returned to Earth 7 August 1971

Apollo 16

Launched 16 April 1972
Landed on Moon 20 April 1972
Descartes
Returned to Earth 27 April 1972

Apollo 17

Launched 07 December 1972
Landed on Moon 11 December 1972
Taurus-Littrow
Returned to Earth 19 December 1972

The exploration of space has been a dream of mankind since humans started to walk the Earth.

While the United States of America focussed on and led the way in landing men on the moon, the Soviet Union was developing and testing its' Soyuz (rocket family). The first Soyuz rocket made its debut in 1966 and has since proved to be a truly magnificent space work-horse:

Soyuz enabled the Soviet Union to lead the way in launching Earth Orbiting Space Stations.

Salyut 1 was the first Space Station launched in April 1971 and then followed by many others.

NASA in the United States launched a Space Station called SkyLab in July 1979 having spent a long time developing a Space Shuttle vehicle.



Later came a Russian Space Station named *Mir* (photo. left).

Mir (meaning “Peace” or “World”) was in Earth orbit from 1986 to 1991.

Following the end of the Soviet Union *Mir* was operated by the new Russian Federal Space Agency (RKA).

Then as a result of international collaborations, the station was made accessible to space travellers from Asian, European and North American nations.

The **International Space Station** launched in November 1998 was a joint endeavour involving

- NASA the United States.
- Roscosmos the Russian Federation.
- ESA the European Space Agency.
- CSA the Canadian Space Agency.
- JAXA a Japanese Space Agency.

China also had a Space Station in Orbit prior to the building of the International Space Station.

Below is a photo of a mural at the Kennedy Space Centre, Florida showing the flags of the International Space Station collaborating nations:



The Americans and the Russians accomplished the first international docking in space between two nations on 17th July 1975. This was labelled as the Apollo-Soyuz Test Project. The world watched on television as the two commanders: Tom Stafford and Alexey Leonov made the first international handshake in space. The two craft spent 44 hours docked together. This joint mission brought about scientific and technical collaboration between two formerly opposing nations.

Following the Apollo-Soyuz Project several NASA space shuttles docked with the *Mir* space station.

The NASA space shuttle was on the drawing board before the first Moon landing the primary aim being to support a future space station. The original idea was to have a fully reusable craft and to launch the craft piggy backed on another craft that landed back on earth somewhat like an aeroplane on a runway. The final design was however different and a throwaway external fuel tank and recoverable rocket boosters were substituted for the aircraft.

Lockheed, McDonnell Douglas, Grumman, and North American Rockwell all submitted proposals to build the shuttle. In July 1972 NASA selected North American Rockwell to build the Space Shuttle.



A photo. of a Space Shuttle Launch (left).

The Shuttle was used to transfer equipment and crew to the International Space Station.

6 Space shuttles were built: Enterprise, Columbia, Challenger, Discovery, Atlantis and Endeavour. Two of the missions ended in disaster. In February 2003 Columbia disintegrated during atmospheric entry, killing 7 crew members. In 1986 Challenger had broken apart soon after lift-off killing 7 crew members.

Endeavour was built to replace Challenger.

The first Soyuz rocket (right) made its debut in 1966 and has since proved to be a truly space work-horse.

The durability of the Soyuz design proved extremely valuable for the transport of the crew and supplies to space stations.

Soyuz rockets supplied the International Space Station and replaced crew members in times when space shuttle usage was suspended during disaster investigations.



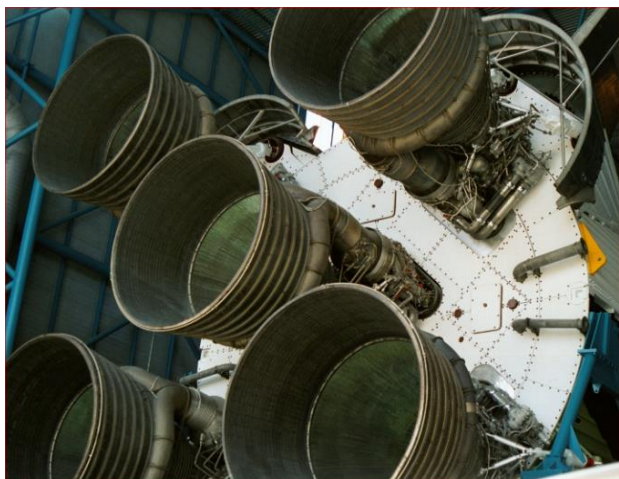
The original space shuttle design idea was to launch the shuttle piggy backed on a launching aircraft.

Virgin Galactic plan to use a Boeing 747 Aircraft to launch their space tourism carrier space craft into Earth orbit.

The European Airbus A380 may have a future potential to be adapted as a space craft launching aircraft.

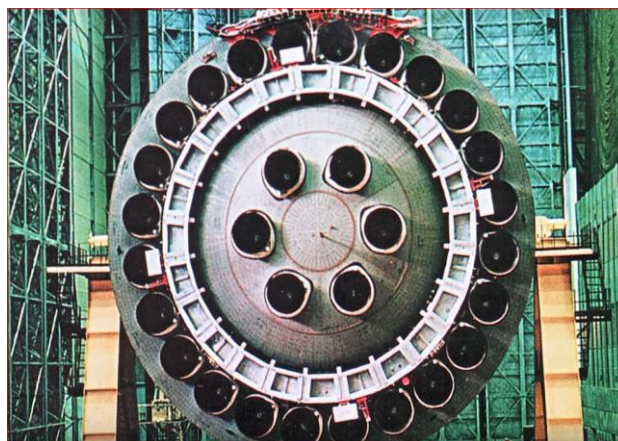
The next logical step in the “Greater Space Endeavour” after the International Space Station is to return men to the Moon and then to establish an **IMb** ... International Moon base. This needs to happen before a manned mission to Mars is planned.

It is over 50 years since the United States of America (USA) first landed men on the Moon.

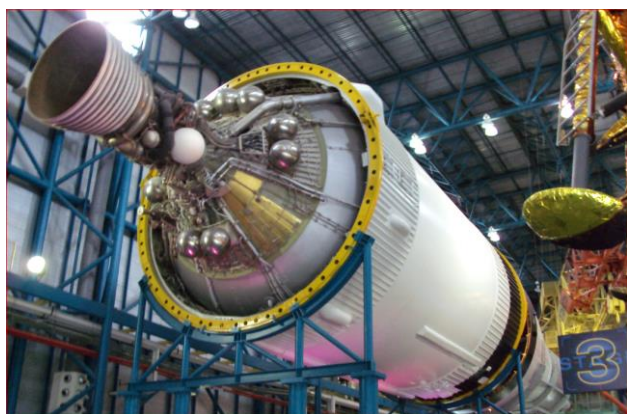


One of the reasons why the USA was successful and the former Soviet Union wasn't in developing a powerful rocket to enable crewed travel to the Moon was that they the industrial capability to develop a set of 5 powerful rocket engines to lift off the Saturn V rocket. (Picture left) Unlike the Soviet development it appears that the project was fully funded. This enabled the rocket motors were thoroughly tested before the assembly into the Saturn V and their final positioning ready to launch.

The Soviet Union did not have the industrial resources to develop large rocket engines and therefore had to use a lot of smaller engines to achieve the required thrust. (Picture right). Adopting this multiple rocket technology created a lot of engineering problems for them having to ensure that all 30 engines had pipework to ensure an equal supply of rocket fuel and that none of the 30 engines failed to ignite or burn correctly.



Soviet engineers did not have an ability to test the rocket motors except for in a live launch. This resulted in a number of launch failures. One of the failures resulted in the N1 rocket crashing into and partially destroying the launch facility.



Nested inside the giant Saturn V rocket was a lunar orbiter (Photo. Left) and a lunar elevation module known as the LEM. (Photo. Below).

The Apollo lunar flights ended in 1972, but the moon has remained of great interest to scientists around the world. NASA is planning to return to the Moon with commercial and international partners to explore together. This will create new knowledge and many opportunities.



NASA has led the way in exploring Mars.

A return to the Moon is a way of proving and improving technology that in time will lead us to the establishment of an international, self-sustainable base on Mars.

There will be a lot to be learned from creating a viable Moon base as a step in the process. This should also result in improvements to the quality of life people enjoy on Earth.

Curiosity Mars
Robotic Explorer.
(Photo. Below):



NASA has so far led the way in exploring the Moon. NASA is planning for the return of humans to the Moon late in 2024. Technology has advanced a lot since the Apollo missions. A new project aims to land a woman and a man on the Moon.

The project has been named **Artemis**. In Greek mythology Artemis was the twin sister of Apollo, the Olympian goddess of the moon.

It is planned to land in the South Polar Region an area that is of particular interest because it may hold ice deposits in permanently shadowed craters.

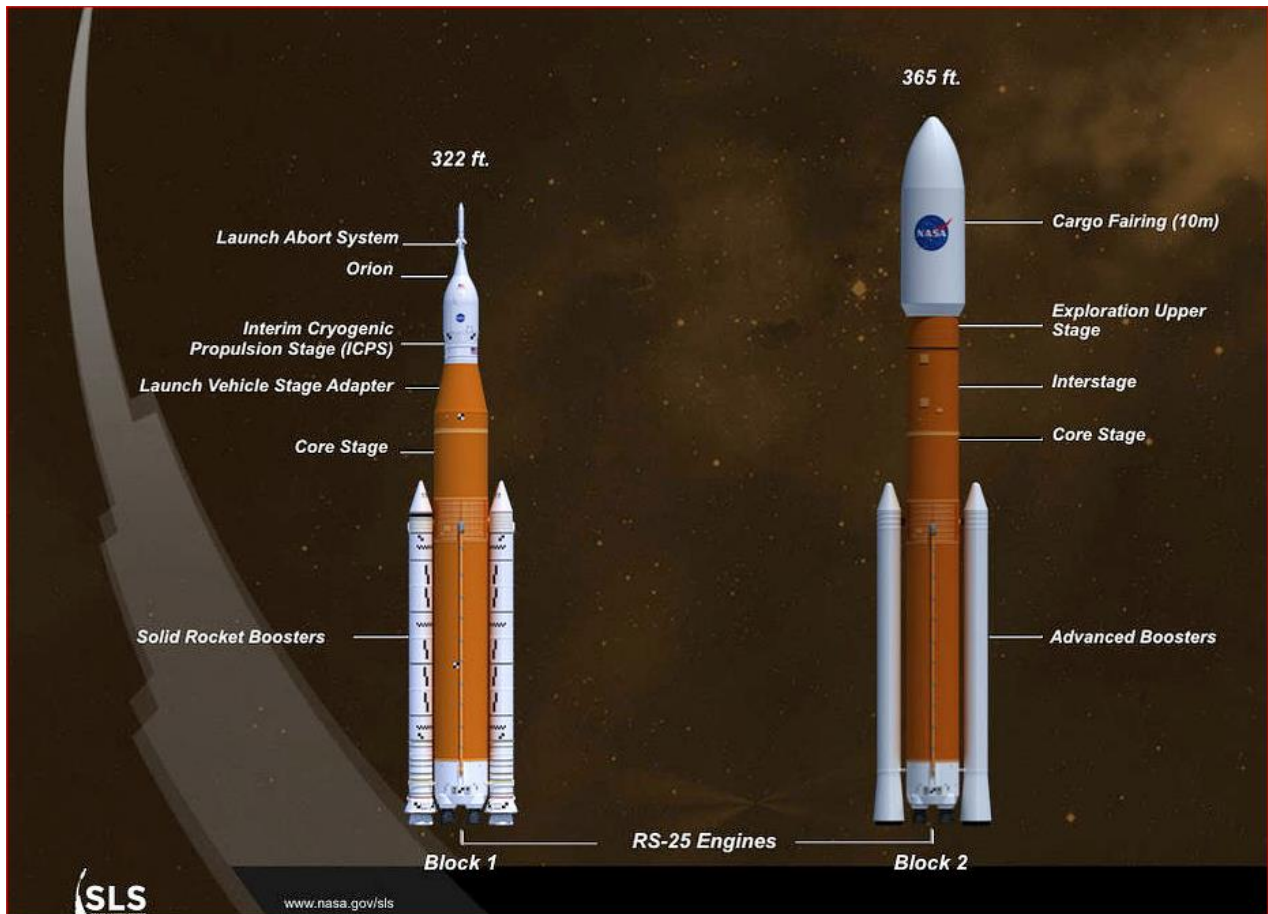
The new powerful rocket being developed, the Space Launch System will send astronauts aboard an Orion spacecraft from Earth to lunar orbit. Artemis will be led by NASA working in partnership with commercial and international partners such as the European Space Agency (ESA), JAXA, and the Canadian Space Agency (CSA).

Ahead of the human return, a suite of science instruments and technology demonstrations will be sent to the lunar surface through commercial Moon deliveries. NASA is working with several American companies to deliver science and technology to the lunar surface through the Commercial Lunar Payload Services (CLPS) initiative.

CLPS Providers listed by NASA in 2019 are:

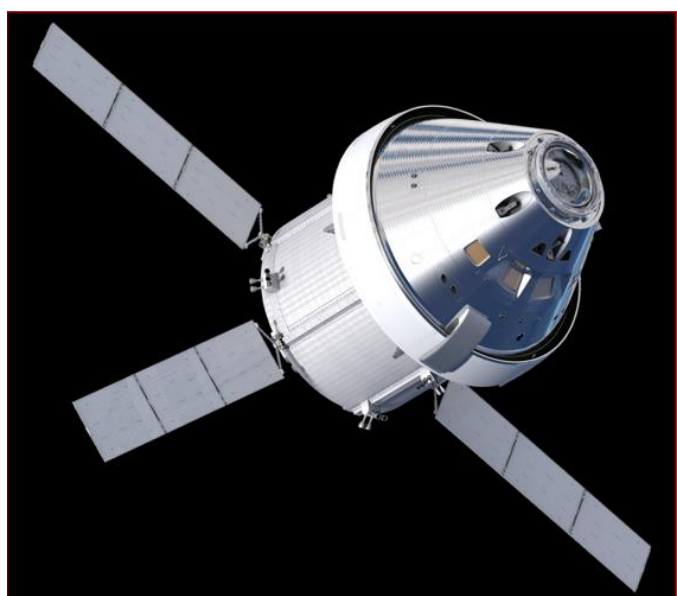
Astrobotic Technology | Blue Origin | Ceres Robotics | Deep Space Systems | Draper | Firefly Aerospace | Intuitive Machines | Lockheed Martin Space | Masten Space Systems | Moon Express | Orbit Beyond | Sierra Nevada Corporation | SpaceX | Tyvak Nano-Satellite Systems.

Below is an artist's impression of the planned SLS ... Space Launch System:



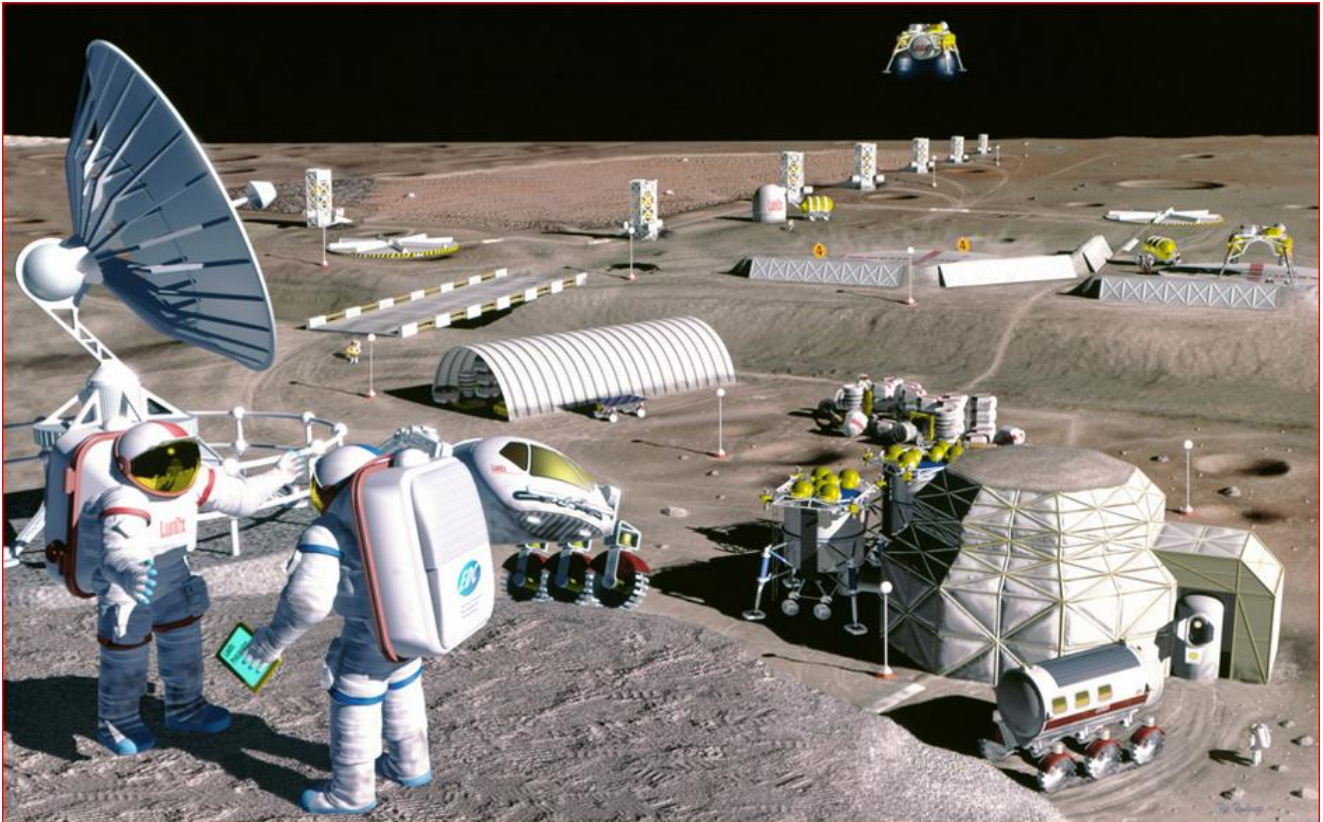
The agency plans to fly two missions around the Moon to test its deep space exploration systems. NASA is working toward launching Artemis I in 2020, an un-crewed flight to test the SLS and Orion spacecraft together. Artemis II, the first SLS and Orion flight with crew, is targeted for launch in 2022. NASA plans to land astronauts on the Moon by 2024 on the Artemis III mission and then about once a year thereafter.

The Orion spacecraft (Picture right):



NASA in partnership with Commercial and other International Space Agencies are planning to land a man and a woman on the Moon in 2024. Science instruments and technology demonstrations will be sent to the lunar surface through commercial Moon deliveries, many before the planned manned landings. **Artemis Phase 1** has 3 planned missions the 3rd mission is the lunar landing.

Below is a NASA artist's impression of what an Artemis, international moon base may get to look like:



"Imagination will often carry us to worlds that never were, but without it we go nowhere" – Carl Sagan

Carl Edward Sagan (Nov.1934 – Dec. 1996) was an American astronomer, cosmologist, astrophysicist, astrobiologist, author and science popularizer. His best known scientific contribution is research on extra-terrestrial life, including an experimental demonstration of the production of amino acids from basic chemicals by radiation. Sagan assembled the first physical messages sent into space: the Pioneer plaque and the Voyager Golden Record, universal messages that could potentially be understood by any extra-terrestrial intelligence that might find them. The Voyager spacecraft (image below). Carl Sagan's narration of "The Pale Blue Dot" is definitely worth viewing:



<https://www.youtube.com/watch?v=wupToqz1e2g>

A **Lunar Gateway** is also under development by NASA and their international partners. This is in effect a solar powered space station in lunar orbit. It will serve as a communications hub, science laboratory and be a holding area for re-usable rovers and other robots and will also have a short-term habitable module. The development includes all of the current International Space Station partners: ESA, NASA, Roscosmos, JAXA, and CSA. Construction will begin early in the 2020's and at the time of the Artemis 3 lunar landing mission is expected to be fairly minimalistic and comprise of only two modules; a Power and Propulsion Unit and an Habitation Module. If the planned 2024 lunar landing proves a success this will bring the Artemis Phase 1 project to an end.

Artemis Phase 2 aims to establish a long-term, sustainable human presence on and around Earth's nearest neighbour the Moon. Success in Phase 2 will help NASA and their international partners prepare for human spaceflight to Mars.



Artist's rendering of NASA's Gateway, which will serve as a home base for missions to the moon and ultimately Mars. (Image credit: NASA)

The Big Six Space Agencies, in alphabetical order are:

1. CNSA, the Chinese National Space Agency
2. ESA, the European Space Agency, a consortium of space agencies of several European countries
3. ISRO, the Indian Space Research Organization
4. JAXA, the Japanese space agency
5. NASA, the American space agency

The Australian Space Agency, a late joiner to the club with an Annual Budget of \$9.8 million in (2019/2020) was established as Australia's national agency with its headquarters in Adelaide South Australia on the 1st July 2018.

This new Australian Government Agency has been given six primary responsibilities:

- (i) To Provide national policy and strategic advice on the civil space sector.
- (ii) To Coordinate Australia's domestic civil space sector activities.
- (iii) To Support the growth of Australia's space industry and use of space across the broader economy.
- (iv) To Lead international civil space engagement.
- (v) To Administer space activities legislation and delivering on our international obligations.
- (vi) To Inspire the Australian community and the next generation of space entrepreneurs.

Establish a long-term, sustainable human presence on a Moon base presents many challenges.

There are more extremes of temperature on the Moon than on earth because there is no atmosphere. The Moon is believed to be a sterile environment, so how sterile it is needs to be measured. There may be seismic activity so this also needs to be monitored.

In order to make a Moon base sustainable as much as possible on the base needs to be automated. Temperature and Air Quality needs to be maintained and the base needs to be able to produce its own sources of food, water and dispose of sewage and other items. AI (Artificial Intelligence) neuro networks will play a role in the optimisation of plant growth. Sample readings of humidity, light intensity, the bases atmospheric pressure. Alpha and Beta radiation at different locations will also need to be measured, recorded and if possible avoided.

The base itself may be a covered dome or be underground in say a former lava tube powered by solar or possibly a source of nuclear energy.

Major gases like Oxygen, Carbon dioxide, Nitrogen and Methane will also need to be measured, monitored, recorded and controlled.

Fish may need to be genetically modified to provide the base with a source of non-plant based food and could provide a recycling source of hydroponic plant nutrients.

The ice on the Moon will need to be melted and stored as liquid water and some of it split into its component elements Hydrogen and Oxygen.

Automated 3D printers will probably need to be developed that can print big things and be controlled remotely. The development of robotic equipment that can manufacture building materials, solar energy panels and arrays is also going to help a lot.

New methods of communications and new batteries designs that work on hostile environments will also need be needed.

What you don't have on the Moon is seasons or the Earth's 24 hour light cycle and colour spectrums. These cycles affect human biology, sleep patterns and circadian rhythms

What happens when a human falls sick or becomes injured also needs to be planned for?

Establishing an International Moon base is not going to be easy and will present many challenges for humankind. Solving the problems, providing for the needs, the challenge of a Moon base will help to resolve many problems that influence life on Earth.

The Moon is a lot closer to the Earth than Mars so developing new solutions and technologies to enable a sustainable base on the Moon should in time make the establishment of a Mars base a lot more doable.

Endeavours like this require a lot of knowledge sharing, commercial involvement and international cooperation. This joint objective should help promote and maintain ... "Peace and Goodwill" amongst nations. ... In time it should prove to be a great investment. □

Space: the New Frontier

The first thoughts that come to the fore about Space in many people's minds are linked to the television series of Star Trek and other science fiction programs which have proved widely popular.

Science fiction books were however popular well before the invention of television. The mind of author, playwright and poet Jules Gabriel Verne born in Nantes, France 8 February 1828 was truly amazing. Widely regarded as one of the fathers of science fiction he stunned the world with his visions of the future. While the world was still at the horse and cart stage he forecast space ships in flights to the moon, submarines, circumnavigation. *Around the world in 80 days* as well as rockets and space satellites.

In his book *From Earth to the Moon and Around the Moon* there are so many similarities it is hard to believe that they were written over 100 years before Neil Armstrong and Buzz Aldrin landed on the moon.



For the blast off site he chose a location in Florida about 225km west of Cape Kennedy and aimed his capsule towards a position where the moon would be, the same as Apollo 11. He compared the blast off to the roar of thunder or the blast of a volcanic explosion. His conical capsule was 4.5 metres high and 2.7 metres in diameter and was named *Columbiad* while the Apollo 11 command vessel named *Columbia* was 3.2 metres high and 3.9 metres in diameter. Verne allowed 97 hours and 13 minutes for the journey. The Apollo 11 time was 103 hours 30 minutes. Verne estimated the velocity for the capsule to be 36,000 feet per second while actual velocity of the American capsule was estimated to be 35,533 feet per second. Both capsules had 3 crew, who experienced weightlessness and orbited the moon at approximately the same height.

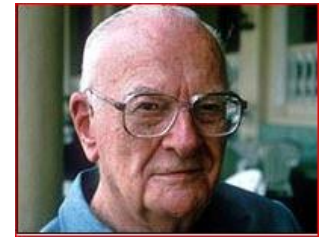
Both capsules landed in the Pacific Ocean and the spacemen were rescued in each case by American warships.

Plans are in place in different countries for further space exploration, people still look to the stars with this question in mind. Do other planetary systems have life?

The SKA – Square Kilometre Array a joint initiative joining observatories the United Kingdom, Australia and South Africa may help to answer this question. Making the **SKA** the largest and most sensitive radio telescope ever built.

There have been many other visionary science fiction writers who lived in more recent times for example: Isaac Asimov and Sir Arthur C. Clarke (photo. below):

Sir Arthur's vivid and detailed descriptions of space shuttles, super-computers and rapid communications systems were enjoyed by millions of readers around the world. He wrote the story-lines for comic-book heroes like Dan Dare and inspired Gene Roddenberry to create Star Trek.



During the 2nd world war, Sir Arthur C Clarke worked on highly-secretive radar and published a paper in which he predicted that, at 22,000 miles above the Earth's surface, communications satellites would sit in geo-stationary orbit, allowing electronic signals to be bounced off them around the globe.



Sir Arthur was an original thinker, a scientific expert whose tales combined technology and good old-fashioned storytelling and whose influence went far beyond the written page.

He told fans at his 90th birthday “I want to be remembered most as a writer. I want to entertain readers and hopefully stretch their imaginations as well”.

Sir Arthur was once described as "the first dweller in the electronic cottage", his vision of the future, and its technology was popularized in films like 2001: A Space Odyssey that captured people's imagination and cult like followers.

There are ideas contained the many books he wrote that to date have not happened that's not to say that they won't be...

The beginning of space flight as we know it now began well after World War Two when the first satellite the Russian Sputnik was launched into earth orbit in October 1957.

Rocket or missile launch attempts had been made as early as 1200s. The most successful launch recorded was a three inch missile that was launched from a site near London in April 1750, it was recorded as going two thirds of a mile in height. The next official notification was a German rocket in April 1931 a decade before this story begins.

Let us also remember that in 1962, John F. Kennedy's inspiring “let's go to the moon” speech when he stood before an audience afraid of Soviet domination in space and declared goals which, for many, seemed outlandish or impossible. The fact that those goals were then fully achieved, in the span of time that Kennedy wanted them to be achieved, goes to show how powerful, resonant, and persuasive he must have truly been. Scientists and Engineers were inspired by his speech to turn the

vision into reality when at that point in time it was an audacious goal that no one knew exactly how it could be achieved...

The first moon orbit was in March 1966 and the first moon landing was in July 1969.

Establishing an International Moon Base and Lunar Orbiting Gateway to the Stars are also audacious goals; no doubt these steps forward will allow the universe to unfold before us and reveal its mysteries to us

In the 2020's we going to be able to begin to: **“Reach for the Stars”**.



A NEW STAR IS BORN

Image credit: NASA the Hubble Telescope.

Hubble's launch and deployment in April 1990 marked a significant advance in astronomy and revealed pictures that helped with our understanding of stars and how the universe truly lives. □