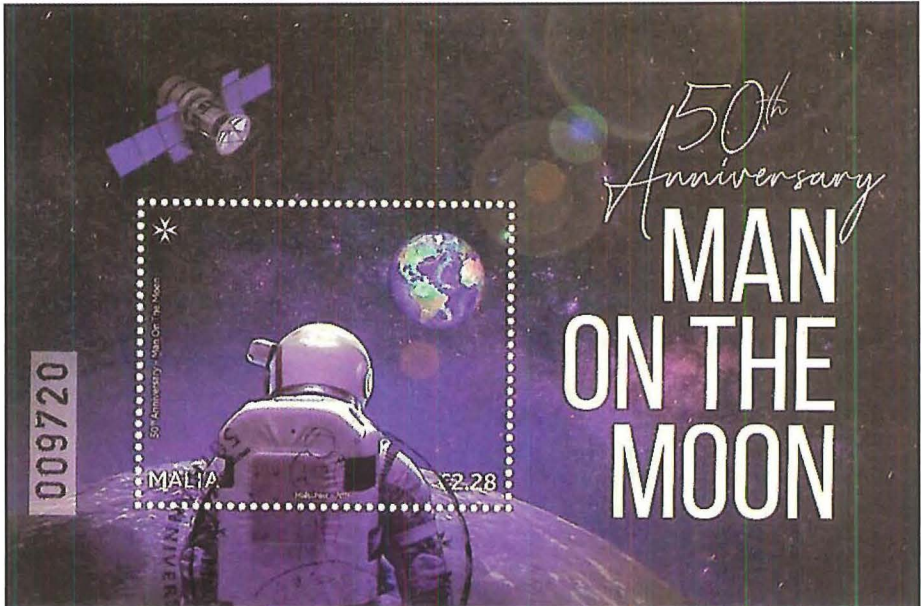


THE CONQUEST OF SPACE

50TH ANNIVERSARY OF THE MOON LANDING

CARMEL LINO CUTAJAR



Since time immemorial Man has been fascinated by the mysteries of space and what lay outside our Earth. Suddenly, the sum of man's accumulated knowledge burst forth with a velocity that was awesome. In the course of 30 years centuries of learning became focussed on man's dreams of adventure in space. What had seemed unattainable became reality when on 20 July 1969 Man set foot on the surface of the Moon.

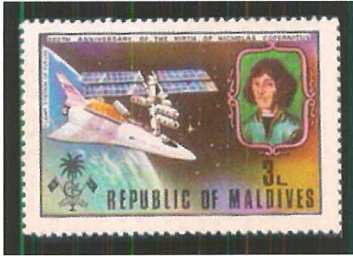
“One small step for a man, one giant leap for mankind”

As Man became more sophisticated and curious he tried to figure out what was happening outside the earth's atmosphere

RENAISSANCE-ERA

SCIENTISTS WHO STUDIED

THE UNIVERSE.



Maldives 1973

NICHOLAS COPERNICUS

(1473-1543). Polish mathematician and astronomer, known for his **HELIOCENTRIC THEORY** (the sun, not the earth, is the centre of the universe).



Malta 2009.

GALILEO GALILEI

(1564-1642). Italian. Referred to as **"THE FATHER OF OBSERVATIONAL ASTRONOMY"**. He used the telescope to observe celestial objects. His support of Copernicus' theories conflicted with orthodox religious beliefs and he was declared a heretic. He was forced to recant and live in home confinement.

17th CENTURY



Fujeira. 1971

JOHANNES KEPLER

(1571-1630). German astronomer and mathematician best known for his **Laws of Planetary Motion:**

"all planets move in an elliptical orbits with the sun as our focus".



Yemen 1970

ISAAC NEWTON (1643 – 1727). Famous English astrologer and mathematician who formulated the **Laws of Motion and Gravitation.**

PIONEERS OF MODERN ROCKETRY

One of the biggest early problems to consider in the endeavour to conquer space was the problem of how to propel an object out into space. This taxed the brain of several pioneers. Among them are:

KONSTANTIN TSIOLKOVSKY

Russian pioneer of space exploration.

He is credited as being the first to study in detail whether rockets could achieve speeds necessary for space travel. In 1903 he published an ideal rocket equation (named after him), a mathematical equation which describes the motion of vehicles using thrust to expel an object with high velocity. He hinted at the exploration of space: “*Earth is the cradle of the mind, but one cannot live in the cradle forever*”.

ROBERT H. GODDARD

Father of Modern Rocketry. First fluid-fuelled rocket.

American scientist. In 1919 he published “*A Method of Reaching Extreme Altitudes*” using calculations that could also be used to land a rocket on the moon. People thought he was an eccentric and labelled him the “Moon Man”. However he continued to work on the quiet. He revolutionized conventional technology by replacing solid propellant with combustable fluids. He secretly built a 10 foot rocket with its engines above propellant tanks, which he launched from a field in his aunt’s farm. It successfully rose to a height of 40 feet. This would be the basis of future rockets. He wrote:

“In no case must we allow ourselves to be deterred from the achievement of space travel, test by test, and step by step, until one day we succeed, cost what it may.”



K. Tsiolkovsky. Russia
1986.



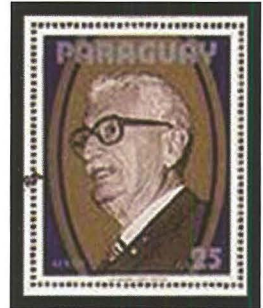
R. H. Goddard. USA 1964

PIONEERS.

HERMAN OBERTH (1894 – 1989)

Romanian/German scientist.

In 1923 he published a classical book “*The Rocket into Interplanetary Space*”, followed in 1929 by “*Ways to Space Flight*”. In these works he explained the mathematical theory of rocketry and discussed the possibility of constructing space stations for travelling to other planets. His contribution was theoretical but valid for future experimentation .



H. OBERTH. *Paraguay*
1971

WERNHER von BRAUN (1912 – 1977)

Development of Ballistic Missiles.

In Jules Verne’s “From the Earth to the Moon” the space capsule is fired from earth into space orbit by a gigantic cannon, which in reality would have flattened everyone in the craft. How to do this effectively and safely needed the brain of some genius. This came in the form of Wernher von Braun, a student of Herman Oberth.



von BRAUN and
Saturn V rocket. *Yemen*

Wernher von Braun was a German, and later American, aerospace engineer. In his early thirties he worked in Nazi Germany as a highly acclaimed rocket development specialist. He developed the dreaded V-2 rocket which hit London and other allied areas in World War II. His great talent was well known to the allies. At the end of the war instead of being prosecuted as a Nazi official he was secretly whisked off to the U.S.A. along with hundreds of other German scientists to liaise with American scientists in the development of ballistic missiles. He developed the powerful Saturn V rocket that propelled the Apollo XI spacecraft to the moon.



SATURN V ROCKET

MAN'S CONQUEST OF SPACE

1957: USSR: LAUNCH OF FIRST ARTIFICIAL SATELLITE IN SPACE

The development of ballistic missiles by Germany towards the end of World War II paved the way for the launch of vehicles that would fuel a space race between the Soviet Union and the USA.

OCTOBER 4, 1957: SPUTNIK I

The Soviets launch the first artificial satellite, SPUTNIK I, into space.



SPUTNIK 1
East Gemany 1957

NOVEMBER.3,1957: SPUTNIK 2

One month later, the Soviets launched SPUTNIK2 which carried a dog, named LAIKA, the first animal in space. She survived several orbits but died a few hours after the launch. Sputnik 2 did 2500 orbits in 162 days



SPUTNIK 2 with dog
LAJKA on board
Hungary 1975

MAY 15, 1958: SPUTNIK 3

Main objective was to carry out scientific research of near space. At the time the Soviets had secret military ambitions in their quest to conquest space.



SPUTNIK 3.
Cuba 1958.

AUGUST 19, 1960: SPUTNIK 5.

Launched with two dogs on board, **BELKA** and **STREIKA**, the first animals to return safely from earth orbit



**SPUTNIK 5 . Inset the two dogs
Belka and Streika.**
Russia 1960.

FEBRUARY 22, 1966.

Two dogs, **VETEROK** and **UGOLYOK**, were launched into space and returned safely after 22 days in orbit.



**Space dogs: Veterok &
Ugolyok.**
Russia 1966.

MAN'S CONQUEST OF SPACE

31 JANUARY, 1958: EXPLORER I AMERICA LAUNCHES ITS FIRST ARTIFICIAL SATELLITE IN SPACE.

Following the successful launch by the USSR of the first two satellites (Sputnik I and II) in orbit, the Americans launched their first satellite, EXPLORER 1, on 31 January 1958 from Cape Canaveral, the USA's participation in the Inter Geophysical Year. This would be the first of a number of EXPLORER missions.

The main scientific instrument on EXPLORER I was a cosmic ray detector designed to measure the radiation environment in Earth orbit. It also provided the first photos of earth from orbit.



EXPLORER I.
Poland 1958

NATIONAL AERONAUTIC AND SPACE ADMINISTRATION

NASA was established in 1958 to keep U.S. space efforts abreast of recent Soviet achievements, such as the launching of Sputnik. In the early 1960s the two super powers raced to become the first country to put a man in space and return him to earth. The Soviets won the race when, in April 12, 1961, they launched cosmonaut YURI GAGARIN into space. The Americans quickly responded by launching ALAN SHEPHERD into space one month later.



THE RUSSIAN VOSTOK PROGRAMME

The VOSTOK PROGRAMME was a USSR spaceflight project to put the first Soviet citizens into low Earth orbit and return them safely. Competing with the USA project MERCURY it succeeded in placing the first human in space, YURI GAGARIN in April 1961.

VOSTOK ACHIEVEMENTS

1961 VOSTOK 1: YURI GAGARIN

First man in space



Vostok 1. Yuri Gagarin.
Maldives

1961 VOSTOK 2: GHERMIN TITOV

First person to spend over. 24 hrs and sleep in space



Vostok 2. G. Titov.
Russia

1962 VOSTOK 3 & 4:

First dual manned spacecraft, launched a day apart and came ..within 6.5 km of one another and communicated via radio



Vostok 3 & 4 In tandem

MAN IN SPACE

FIRST MAN IN SPACE IN EARTH ORBIT

12 April 1961. VOSTOK 1
YURI GAGARIN (Russian)



Ajman. Yuri Gagarin

6 August 1961. VOSTOK 2
GHERMAN TITOV (Russian)
The first manned flight over 24 hours.
Titov was the first man to sleep in space



Czech. Rep. Gherman Titov

16 June 1963. VOSTOK 6
VALENTINA TERESHKOVA (Russian)
First woman in Space.



Cuba. Valentina Tereshkova

RUSSIAN VOSTOK PROGRAMME (CONT)

VOSTOK ACHIEVEMENTS:

1963 VOSTOK 5:

JOINT MISSION OF APPROXIMATION WITH VOSTOK 6. Launched 14 June 1963. Com. Valery Bykovski. 5 days in space.



VOSTOK 5. Val. Bykovski Russia



1963 VOSTOK 6:

FIRST WOMAN IN SPACE.
VALENTINA TERESHKOVA



VOSTOK 6



VOSTOK 6 Maldives
VALENTINA TERESHKOVA

FIRST AMERICANS IN SPACE.

5 May 1961. MERCURY “FREEDOM 7”

ALAN SHEPHARD,

The first American astronaut (and second person after the Russian Gagarin) to travel in space, but did not reach orbit.



20 Feb 1962. MERCURY “FRIENDSHIP”

JOHN GLENN.

The first American to achieve orbital space and return safely to earth. The flight lasted just under 5 hours.



The **MERCURY SPACE PROJECT**

was America's first manned spacecraft. It was a small capsule which could only accommodate one person. Powered by an Atlas rocket.

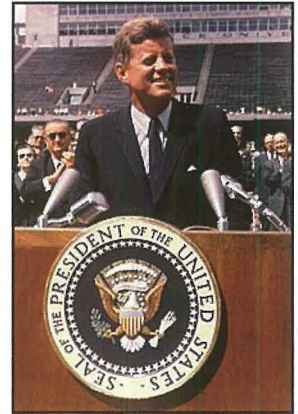


MERCURY CAPSULE

“WE CHOOSE TO GO TO THE MOON”

President John F. Kennedy.
Sep. 12, 1962

When John F. Kennedy became President the USA was losing the space race with the Soviet Union which had already put the first man, Yuri Gagarin, in space in 1961. Kennedy stood before Congress and proposed that **“the US should commit itself to achieving the goal, before this decade is out, of landing a man on the moon and returning him safely to Earth”**. Despite some reservations Congress approved the launch of the APOLLO programme (at a cost of some \$22 billion).



*Pres. Kennedy
Rice Univ. Sep 12, 1962*

On September 12, 1962, a warm and sunny day, President Kennedy delivered his speech before a crowd of about 40,000 people in the Rice University football stadium. Inter alia, he stated:

“We choose to go to the Moon in this decade and do 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 the challenge is one that we are willing to accept, one we are unwilling to postpone, and one we intend to win”

His goal was fulfilled in July 1969 with the successful Apollo 11 Moon landing, but he did not live to see it (he was murdered in 1963). The Apollo Project remained a memorial to him.



FIRST MEN TO WALK IN SPACE (1965)

ALEXEI LEONOV (USSR)
18/ 19 March 1965.
(with P. Belyayev on VOSKHOV 2)



Leonov in space. Voskhov 2 capsule. *Hungary.*

EDWARD H. WHITE (USA)
3/7 June 1965
(with James McDivitt on GEMINI 4)
Edward White died two years later
(1967) when Apollo 1 blew up before
launch



White walking in space using a hand-held maneuvering unit to propel himself. *Hungary.*

AMERICA'S PROJECT GEMINI

Following on the Mercury project GEMINI's objective was the development of space travel technology to support the future Apollo mission to land men on the moon. Among its achievements were the ability of astronauts to work outside the spacecraft and pioneering the manoeuvres for space rendezvous and docking.

GEMINI 4 (July 1965)

EDWARD WHITE: FIRST AMERICAN TO WALK IN SPACE



Hungary. GEMINI 4.
ED. WHITE

GEMINI 6 & 7 (December 1965)

PARALLEL FLIGHTS WITH ORBITAL RENDEZVOUS.
(no docking)



Hungary. GEMINI 6 & 7.
RENDEZVOUS

GEMINI 8 (July 1966)

FIRST ORBITAL DOCKING BETWEEN TWO SPACECRAFTS



Hungary. GEMINI 8.
ORBITAL DOCKING

AMERICA'S APOLLO PROJECT



“REACHING FOR THE MOON”

The **Apollo project**, launched in 1967, was designed by NASA with a view to landing the first man on the moon, something which it succeeded in doing in July 1969 (Apollo 11) and subsequent Apollo flights up to 1972. Apollo used Saturn rockets as launch vehicles.

APOLLO 1 DISASTER 1967

Crew:

Gus Grissom,
Roger Chaffee,
Ed White

These three astronauts **died on January 27, 1967** when a blaze erupted in their command module during pre-flight testing in preparation for the first manned Apollo flight.

The disaster left families in mourning and a nation stunned.



*Romania 1972: “Astronaut Heroes”.
The unfortunate crew of Apollo 1.
Grissom-Chappelle-White*

APOLLO PROJECT

1968 APOLLO 8

Launched from Cape Kennedy 21
December 1968.

Crew:

Frank Borman (commander)

James Lovell

William Anders

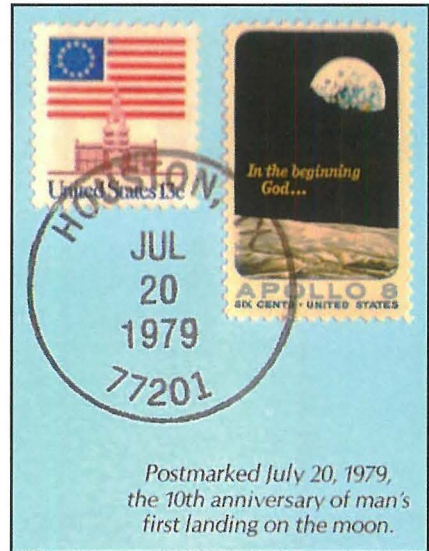
Apollo completed 10 lunar orbits

On Christmas day Anders read from
the Bible:

*“In the beginning God created
Heaven and Earth”*

Borman sent Christmas greetings:

“From the crew of Apollo 8. Good
luck, a merry Christmas and God
bless you all – on the good Earth”



*USA stamp (10th anniversary of moon landing).
Shows the ‘Earth rise’, a photo taken by Apollo
8 commander, Frank Borman, from lunar orbit
showing planet Earth floating in the sky.*

APOLLO PROJECT

1969 (May 10). Apollo 10

Crew: *Thomas Stafford (commander), G. Cerman, J. Young*

Objective: Apollo 10 was the fourth American manned mission designed as a ‘dress rehearsal’ for the first moon landing, testing all the components and procedures and descending very close to the surface of the moon short of actually landing. Mission duration: 8 days.



Apollo 10

*Lunar lander
“Snoopy”*

*Redocking of lander
and mother ship*

Ras Al Khaima. Apollo 10..

APOLLO PROJECT

1969 (JULY 16). APOLLO 11

FIRST MANNED LANDING ON THE MOON

Launched: 16 July 1969 from Kennedy Space Center.

CREW: *Neil Armstrong (mission commander), Buzz Aldrin, Michael Collins*

MOTHER SHIP: "COLUMBIA". LUNAR LANDING MODULE "EAGLE"

NASA worked meticulously to reach the stage when man could attempt to land on the moon. Apollo 10 had been a "dress rehearsal". Still there were some high risks, e.g. the lunar module escape from the moon surface was untried and there were no emergency plans should the astronauts be stranded on the moon surface. Nevertheless the decision was taken to proceed. Fortunately all went to plan and the astronauts re-entered and landed on Earth on July 24, 1969 off Hawaii.



APOLLO 11. Mother ship (COLUMBIA) and Lunar landing module (EAGLE) moon descent and ascent and re-docking

Splash down off Hawaii

APOLLO PROJECT

1969 (JULY 20). APOLLO 11

FIRST MEN ON THE MOON



USA commemorative stamp postmarked July 20, 1979, the 10th anniversary of the moon landing



ASTRONAUTS:
Top: Armstrong
Bottom: Aldrin and Collins

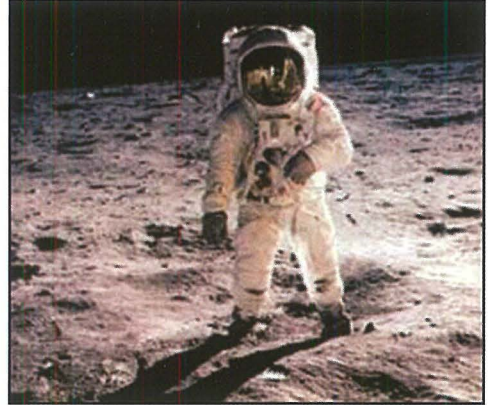
On 20th July 1969, the lunar module (“Eagle”) with Armstrong and Collins inside, separated from the mother ship (“Columbia) and descended smoothly towards the moon surface. Armstrong had to take manual control in the last few feet and landed safely. **“The Eagle has landed”** he announced to Earth.

MEN ON THE MOON.

20 JULY 1969.



APOLLO 11 ASTRONAUTS: *Armstrong, Aldrin, Collins.*



NEIL ARMSTRONG: THE FIRST MAN TO STEP ON THE MOON SURFACE: *“That’s one small step for a man, one giant leap for mankind”*



BUZZ ALDRIN: SECOND MAN TO STEP ON THE MOON SURFACE.
Photo taken by Armstrong.



The astronauts' footprints will last on the moon surface forever because there is no wind to blow them away.

APOLLO PROJECT

1971. APOLLO 15

LAUNCHED: 26 JULY 1971.

Mission duration: 295 hours (12+ days)

Objective: Apollo 15 was the first lunar mission to use a motorised roving vehicle (“ROVER”) to explore the moon’s surface. Many scientific manoeuvres and specimen collections were carried out.



APOLLO 15. James Irwin on the rocky moon surface saluting the American flag. Behind him is the Lunar Module (“Falcon”)



APOLLO 15. The first lunar Rover in action.
Crew: David Scott, James Irwin, A.N. Wordena

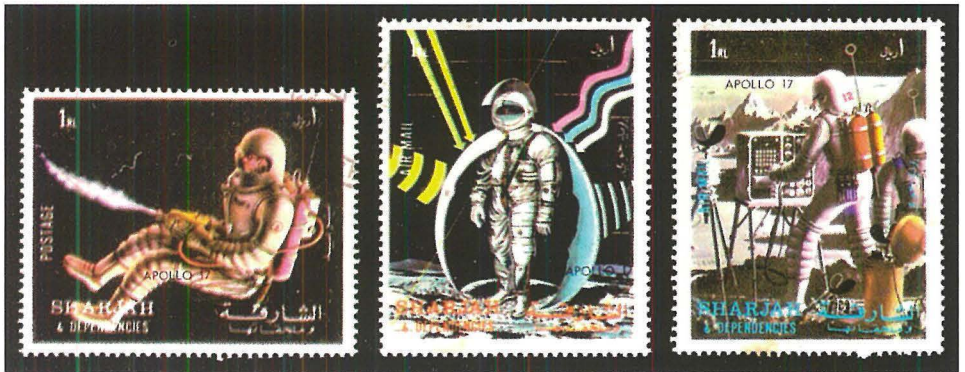
APOLLO PROJECT

1972. APOLLO 17

LAUNCHED DECEMBER 1972.

The last Apollo mission to land on the moon.

The duration of the mission was 12.6 days. The time on the lunar surface was 75 hours.



SHARJAH. APOLLO 17. Harrison Schmidt was the first trained geologist to walk on the moon and Eugene Cernan, commander of Apollo 17, the last man to do so (December 14, 1972).

ON GOING RUSSIAN SPACE PROGRAMME 1969.

SOYUZ 4 & 5.

First docking between two manned craft in earth orbit and exchange of crews beautifully illustrated in a postal 10th anniversary set from Cuba (1979)



Rocket launch

Soyuz 4 & 5 in orbit

Docking procedure

SOVIET “MOONWALKER”

LUNOKHOD PROGRAMME



East Germany. Lunokhod . Moon rover

LUNOKHOD was a series of Soviet robotic rovers designed to land on the moon between 1969-1977.

The Lunokhods were transported to the lunar surface by LUNA spacecrafts launched by Proton-K rockets.

They successfully carried out many important experiments on the lunar surface.

RUSSIAN LUNA PROGRAMME

(USSR 1959-1976)

The **LUNA PROGRAMME** was a series of **robotic space crafts** sent to the moon by the Soviet Union which accomplished many firsts in space exploration, performing many experiments, studying the moon's chemical composition, gravity, temperature and radiation. **Twenty four Luna spacecrafts** were formally acknowledged although there were probably many more.



LUNA 16
Russia 1970



LUNA 17
Hungary 1975



LUNA 24
Cuba 1978

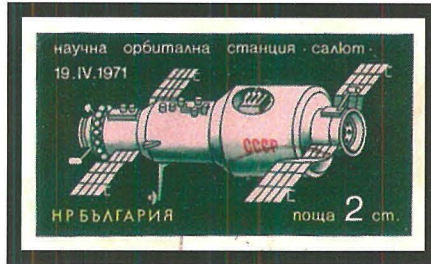
LUNA 16
16 Sep. 1970
**Collected the first
flight to the moon**

LUNA 17
15 November 1970
**Carried the first
samples from
space rover**

LUNA 24
9 August 1976
**The last LUNA
Russian robotic**

1971. THE FIRST SPACE STATION

SALYUT 1 (USSR)



SALYUT 1. The first space station
Russia 1971

April 19, 1971.

The Russians launched SALYUT I the first unmanned space station.

June 6. Three Russian astronauts were launched on SOYUZ 11.

They successfully docked with SALYUT and remained on the space station for 3 weeks (383 orbits). Unfortunately disaster struck when Soyuz was re-entering earth when a ventilation valve was jolted open, depressurizing the interior and **all three astronauts died tragically.**

Despite an array of problems, SALYUT 1 made important progress toward living and working in space and paved the way for future space stations.



SALYUT 1.
Cuba



SOYUZ 11 docking with SALYUT 1
Maldives

1973. SKYLAB

AMERICA'S FIRST SPACE STATION

SKYLAB was the first United States space station, launched without crew by NASA, powered by a Saturn V rocket, on **14 May 1973**. It included a workshop, a solar observatory, and several hundred life science and physical experiments including photographing the Earth.

Subsequently Skylab was visited by several astronaut crews on Apollo rockets.

The launch of Skylab almost ended in failure as during the launch the station was damaged when a protective shield tore away taking one of the main solar panels with it and leaving the other one jammed at the side. This deprived Skylab of most of its electrical power and also removed protection from intense solar heating, threatening to make it unusable. It took all the expertise of the first Apollo crew to arrive on site to install a new heat shade and to free the jammed solar panels to save Skylab.

Skylab did almost 35,000 orbits and was occupied for 171 days. It was brought back to earth on 11 July 1979 when it disintegrated over the Indian Ocean and Western Australia.



SKYLAB. Note only one solar panel as the one on the other side was damaged and tore away.

INTERNATIONAL COOPERATION IN SPACE

FIRST AMERICAN-SOVIET MANNED SPACE MISSION

APOLLO---SOYUZ XIX (JULY 1975)

For many years the USA and Soviet Union had been locked in a grim and costly race for military applications of space technology. The time was now ripe for a better option of cooperation and sharing of technology for possible future international rescues in space.

On 15 July 1975, SOYUZ XIX blasted off from Russia and APOLLO from Cape Canaveral USA. Two days later the two spaceships, while moving at 17,000 miles per hour, successfully linked up. The two commanders Stafford (Apollo) and Leonov (Soyuz) slowly crawled into the docking module and shook hands, a historic meeting of the two super powers.



17 JULY 1975. RENDEVOUX SOYUZ XIX AND APOLLO
(L) East Germany (R) POLAND

THE SPACE SHUTTLE (1981-2011)

NASA designed the Space Shuttle as a reusable low Earth orbital spacecraft, designed to transport people and cargo (such as satellites and building parts for the International Space Station) and to be able to return to the Earth's surface.

The shuttle consisted of three components: a winged orbiter and two solid rocket boosters (both reusable) and an expendable external fuel tank.

Between 1981 and 2011 five shuttle crafts were launched: COLUMBUS (1981, *blew up killing all seven crew*); CHALLENGER (1982), DISCOVERY (1983, *carried the Hubble space telescope*); ATLANTIS (1985); ENDEVOUR (1991). The project was decommissioned in 2011.



Shuttle launch – Booster jettison (reusable) -- external fuel tank jettison (expendible)

THE INTERNATIONAL SPACE STATION



The **International space Station (ISS)** is a habitable space station in low Earth orbit, a joint project between five participating space agencies: NASA (USA), Rocosmos (Russia), ESA (Europe), JAXA (Japan), and CSA (Canada). **Launched in 2000** it is still very active and serves as a research laboratory suited for the testing of spacecraft systems and equipment and other experiments.

The Space Station consists of pressurized habitation modules, structural trusses, solar arrays, radiators, docking ports, experiment bays and robotic arms. It has been visited and lived in by visitors from various countries and maintains an average altitude of 400 kilometres, circling the earth every 92 minutes.

