

INTERNATIONAL SPACE MISSION

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1. New Horizons

- [Launch Date: 19 January 2006, Launch Site: Cape Canaveral]
- It is launched by NASA, being an interplanetary space probe.
- The primary objective was to make the study of Pluto and a secondary mission in fly-by study of one or more other Kuiper belt objects.

- In January 2015: It started its approach towards Pluto. In July 2015, it flew 12,500 kilometres above the surface of Pluto to make it the first spacecraft to explore the dwarf planet.
- New Horizons was saluted for accomplishing the **first direct investigation of Kuiper belt objects.**
- Now, New Horizons **work has been extended till 2021.**

2. Juno

- [Launch Mass: 3,625 kilograms, Launch date: 5 August 2011, Launch site: Cape Canaveral]
- It is a space probe **launched by NASA** and **orbiting around the planet Jupiter.**

Objectives of Juno

- Measurement of the composition, gravity, magnetic field and polar magnetosphere of Jupiter.
- The spacecraft will also search for clues **about the formation of the planet, inclusive of having a rocky core, the amount of water it contains within the deep atmosphere, mass distribution and its deep winds reaching the speeds of 618 kilometres per hour. It provides light on Earth origin.**
- It is the second **spacecraft after the nuclear powered Galileo Orbiter (1995–2003) to orbit Jupiter.**
- Achievements Juno is the **first Jupiter's mission making the usage of solar panels in place of the radio isotope** based thermoelectric generators.

3. Titan

[Proposed launch date: between 2020 and 2029, Launch mass: 1613 kilograms]

This is a Saturn exploration mission proposed for the future. The mission has been proposed to study Saturn and its Moon—**Titan and Enceladus**.

The Titan Saturn system mission (TSSM) was officially decided in January 2009 by the **merging of ESA's Titan and Enceladus Mission with NASA's Titan Explorer study**.

The **TSSM** mission consists of an orbiter and two titan exploration probes: a 'hot air balloon' that will float in Titan's clouds and a 'lander' that will splash down on one of its methane seas.

Objectives of TSSM

- It will try to identify the reason behind Titan's origin and its evolution models.
- Recover information on Enceladus and Saturn's magnetosphere.

4. CASSINI – HUYGENS (Cassini Orbiter and Hygens: Lander)

[Launch mass: 5,712 kilograms, Launch date: 15 October 1997, Launch site: Cape Canaveral]

Cassini: Huygens is an **unmanned spacecraft** sent to the planet Saturn.

It is the **fourth space probe to visit Saturn** and the **first to enter orbit**.

- Team: **Sixteen European countries and the US** are responsible for designing, building, flying and collecting data from Cassini Orbiter.
- It completely **destroyed on 15 September 2017**.

Achievements

- The **first mission to successfully complete** in various observations: depth, up-close **study of Saturn and its realm from orbit.**
- **Titan was revealed to have Earth like conditions: rain, rivers, lakes and sea.**
- Among the most surprising discoveries were **geysers erupting on Enceladus.**
- First complete view of the North polar hexagon and **discovery of giant hurricanes at both of the Saturn's poles.**

5. NASA to Launch Dragonfly

NASA plans to launch an unmanned nuclear-powered drone, Dragonfly as early as 2026 to search for life on Saturn's largest moon, Titan.

Why study of Titan?

- Titan is an **analog to the very early Earth**, and **can provide clues to how life may have arisen on our planet.**
- Titan is larger than the planet Mercury and is **the second largest moon in our solar system.**

6. Mars Science Laboratory (MSL)

[Launch mass: 3.839 kilograms, Launch date: 26 November 2011, Launch site: Cape Canaveral]

MSL is a **robotic space probe mission to Mars** launched by **NASA**, which **successfully landed 'Curiosity,' a Mars rover, in Gale Crater** on 6 August 2012.

'Curiosity' is about **twice as long and five times as heavy as the previous Mars rovers 'Spirit' and 'Opportunity'** and carries over ten times the mass of scientific instruments.

Scientific goals of MSL

1. **Determining the landing sites and its habitability**, including the **role of water**.
2. The **study of the climate and the geology of Mars**.
3. All of these are **important for preparing a future manned mission to Mars**.

Objectives

- Study of organic carbon compounds, building blocks of life, identify biosignature.
- Investigate chemical and mineralogy of Martian surface.
- Assess Martian atmosphere, determine present state, distribution and cycling of water and CO₂.
- Characterise the surface radiation.

7. Curiosity Rover

[Launch mass: Rover only of 899 kilograms, Launch date: 26 November 2011]

Curiosity is a **car-sized robotic rover exploring Gale Crater on Mars** as a **part of NASA's Mars Science Laboratory mission**.

Since landing on 6 August 2012, it is still working.

In December 2012, Curiosity's mission was extended to an indefinite period. **The goals and objectives remain same as those of Mars Science Laboratory.**

8. ExoMars Programme

It is a **joint endeavour** between **ESA** and the Russian space agency, **Roscosmos**. The primary goal of the ExoMars programme is to address the question of **whether life has ever existed on Mars**.

The programme comprises two missions.

- The **first** launched in March 2016 and consists of the **Trace Gas Orbiter (TGO)** and **Schiaparelli**, an entry, descent and landing demonstrator module. **TGO's** main objectives are to search for evidence of methane and other trace atmospheric gases that could be signatures of active biological or geological processes. The **Schiaparelli** probe crashed during its attempt to land on Mars.
- The **second**, comprising a rover (**ExoMars Rover**) and surface platform, is planned for **2022**. Together they **will address the question of whether life has ever existed on Mars**.

9. Messenger Mission

MESSENGER was a **NASA robotic spacecraft that orbited the planet Mercury between 2011 and 2015**. The spacecraft was launched aboard a Delta II rocket in August 2004 to study Mercury's chemical composition, geology, and magnetic field. MESSENGER entered orbit around Mercury on 18 March 2011, becoming the first spacecraft to do so.

The MESSENGER mission was planned to study **Mercury's features and environment** from orbit.

Particularly, the mission's scientific objectives were:

- Characterising the planet surface's chemical composition.
- Studying the geologic history of planet.
- Elucidating the global magnetic field nature (magnetosphere).
- Determining the core's size and state.
- Determining the poles' volatile inventory.
- Studying the planet's exosphere nature.

10. NASA'S ORION SPACECRAFT

NASA's Orion spacecraft is **designed to carry humans further than they've ever gone before.**

Orion will function as the exploration vehicle which will take the crew to space, **provide capability for emergency abort**, sustain the crew at the time of travelling to space, and **provide safer re-entry from deep space return velocities.** Orion will be launched from NASA's new heavy-lift rocket, the System for Space Launch.

NASA has successfully finished the last test for qualifying Orion's space capsule's parachute system for onboard flights with astronauts, ahead of its mission in sending humans to the Moon and beyond.

The parachute system is the lone system that must assemble itself in mid-air and must be able to keep the crew safer in scenarios of numerous failures, for instance mortar failures which avoid deploying a single parachute type, or circumstances causing the failure of some of the components of parachute textile.

11. Maven Spacecraft

The MAVEN mission was **launched on November 18, 2013**, and **went into orbit around Mars on September 21, 2014**.

Mars Atmosphere and Volatile Evolution (MAVEN) mission was **devised by NASA** for studying the Martian atmosphere during the Mars orbiting.

MAVEN was **launched aboard through an Atlas V launch vehicle**.

Mars Atmosphere and Volatile Evolution (MAVEN) finished its chief mission in the November 2015 and since that time, has been **functioning in an extended mission**, continuing the Mars' upper atmosphere investigation and exploring further opportunities for science that the new relay orbit will bring. **It also discovered two new types of Martian auroras — diffuse aurora and proton aurora.**

MAVEN has **demonstrated** that the **majority of the carbon dioxide (CO₂) on the planet has been lost to space.**

12. Parker Solar Probe

NASA's historic Parker solar probe launched on 12 August 2018 from the Cape Canaveral.

It is a **small car sized spacecraft**, will travel at a distance of **4 millions miles from the Earth surface**. It will be **first ever mission to touch the Sun**.

About the mission

Parker Solar Probe will travel closer to the Sun's surface than any other spacecraft had done before, through the **Sun's atmosphere**, facing **vicious conditions of heat and radiation and eventually providing humankind with the closest-ever star observations.**

The corona is hotter than the Sun's surface and also give rise to the solar wind which being charged particles has a continuous flow that infuses the solar system.

Capricious solar winds cause turbulence in Earth's magnetic field and can play havoc with Earth's communications technology.

NASA anticipates the results will facilitate scientists for forecasting changes in Earth's space environment.

Parker Solar Probe

On 12 August 2019, NASA's Parker Solar Probe completed a year in service.

It is **part of NASA's "Living With a Star" programme** that explores different aspects of the Sun-Earth system. The probe seeks to gather information about the Sun's atmosphere and NASA says that it **"will revolutionize our understanding of the Sun"**. It is also the closest a human-made object has ever gone to the Sun.

13. Solar Orbiter Mission (SoLO)

Solar Orbiter (SoLO) mission **was launched on 10 February 2020 with 7 years lifespan.**

The mission is a **collaboration between ESA (the European Space Agency) and NASA.**

The spacecraft was **launched from Cape Canaveral** on a United Launch Alliance **Atlas V rocket.**

About Solar Orbiter:

- Solar Orbiter is a mission **dedicated to solar and heliospheric physics.**

- This is the **first mission that will provide images of the sun's north and south poles** using a suite of six instruments on board that will capture the spacecraft's view.
- It is a **seven-year mission and will come within 26 million miles of the sun**. It will be able to brave the heat of the sun because it has a custom **titanium heat shield coated in calcium phosphate** so that it can endure temperatures up to 970 degrees Fahrenheit.
- **What drives the solar wind and where does the coronal magnetic field originate from?**

14. PUNCH Mission

(Polarimeter to Unify the Corona and Heliosphere) **NASA has selected Texas-based Southwest Research Institute to lead** its PUNCH mission which will image the Sun.

This is a landmark mission that will image regions beyond the Sun's outer corona.

Dipankar Banerjee, solar physicist from **Indian Institute of Astrophysics** is also a **Co-Investigator** of the PUNCH mission.

It is focused on understanding the transition of particles from the Sun's outer corona to the solar wind that fills interplanetary space. It will consist of a constellation of four microsatellites that through continuous 3D deep-field imaging, will observe the corona and heliosphere as elements of a single, connected system. **The mission is expected to be launched in 2022.**

15. KEPLER Mission

The Kepler space telescope fuel got exhausted and will be retired after a 9-1/2-year mission. Presently orbiting the Sun, nearly 156 million km from the Earth, the spacecraft will drift from our planet further when its radio transmitters will be turned off by mission engineers.

About Kepler Mission

- **Launched in the year 2009**, for **surveying the Milky Way galaxy region** so as to **discover hundreds of Earth-size and smaller planets in or around the habitable zone** and determining in our galaxy, the fraction of the hundreds of billions of stars that might have such planets.
- As on March 2018, 2,342 planets had been found confirmed by the Kepler; added potential planets, and its finding of exo-worlds stands at 4,587.

Habitable zone: If a planet is too closer to the star it orbits, any water on the surface rapidly boils off, producing a steam atmosphere. If the planet is too distant from the star, any water on the surface freezes. The **habitable zone (or “Goldilocks zone”)** is the range of orbital distances from a star at which liquid water can exist on the planet surface. This distance range changes depending on the star size and temperature. Earth is in the Sun habitable zone, being one of the reasons our planet has liquid water like oceans and lakes.

16. Transiting Exoplanet Survey Satellite (TESS)

The Transiting Exoplanet Survey Satellite (TESS) is a **NASA mission** that will **look for planets orbiting the brightest stars in Earth’s sky**. It was led by the Massachusetts Institute of Technology with seed funding from Google. **The mission will monitor at least 200,000 stars for signs of exoplanets, ranging from Earth-sized rocky worlds to**

huge gas giant planets. TESS, however, will focus on stars that are 30 to 100 times brighter than those Kepler examined.

This will help astronomers better understand the structure of solar systems outside of our Earth, and provide insights into how our own solar system formed.

17. Dawn Asteroid Mission

Since its launch in the year 2007, the unmanned spacecraft has travelled 4.3 billion miles (6.9 billion kilometers).

The only spacecraft ever to orbit a cosmic body in 2011, in the main asteroid belt between Mars and Jupiter when it started orbiting around the asteroid Vesta.

Dawn, after running out of fuel in 2018 , being the only NASA spacecraft launched 11 years ago ,that studied two of the largest objects in the asteroid belt, has ended its mission.

18. NASA'S OSIRIS-REX

The NASA OSIRIS-REx mission **launch took place on September 8, 2016.** Since then, the spacecraft is **travelling for two years** through space for **reaching its target, primitive asteroid Bennu,** in October, 2018.

NASA'S OSIRIS-REX spacecraft has discovered hydrogen and oxygen molecules traces, which being part of the water formula and thus the potential for life.

It entrenched in the asteroid Bennu's rocky surface, where it will grab a sample of rock and dust and bring it back to the Earth.

19. Voyager Mission

The NASA's Voyager mission **was launched in the 1970's, to explore the outer planets.**

This probe is **still going in interstellar space.**

- The Voyager Interstellar Mission (VIM) mission goal is to expand the NASA solar system exploration ahead of the outer planets neighborhood to the outer limits of the Sun's sphere of influence, and possibly away from it.

20. ICESAT and ICESAT-2

ICESat (Ice, Cloud and land Elevation Satellite) mission send for **measuring ice sheet mass balance, cloud and aerosol heights, land topography and vegetation characteristics as a Earth Observing System.**

The Ice, Cloud and land Elevation Satellite-2 (ICESat-2) is the 2nd-generation of the laser altimeter ICESat-1 mission (January 13, 2003 to August 14, 2010).

ICESAT 2 was launched in 5 September 2018 from Vandenberg Air Force Base in California, into a near-circular, near-polar orbit with an altitude of approximately 496 km.

It was designed to operate for three years and carry enough propellant for seven years.

- NASA's ICESat-2 **will map ice sheets melting in Antarctica and the resulting rising sea level across the globe, thereby assisting in the improvement of climate forecasts.**

- **The satellite is measuring the sea ice height to inside an inch**, tracing the unmapped Antarctic valleys terrain , surveying of remote ice sheets, and peering through forest canopies and shallow coastal waters.

21. ARTEMIS PROGRAM - Moon

Artemis- Acceleration, Reconnection, Turbulence and Electrodynamics of Moon's Interaction with the Sun. It is **NASA's next mission to the Moon**.

With the Artemis program, **NASA will land the first woman and next man on the Moon by 2024**. Artemis was the twin sister of Apollo and goddess of the Moon in Greek mythology.

Objective

To measure what happens when the Sun's radiation hits our rocky moon, where **there is no magnetic field to protect it**.

22. ICON MISSION

National Aeronautics and Space Administration (NASA) has launched a satellite ICON to **detect dynamic zones of Earth's Ionosphere**. The satellite **Ionosphere Connection Explorer (ICON)** was launched from an aircraft over the Atlantic Ocean near the **Florida coast on 11 October 2019** with **two years lifespan**. The ICON satellite will study the Earth's Ionosphere. It includes various layers of the uppermost atmosphere where free electrons flow free electrons flow freely.

23. CHANG'E MISSION

The Chinese **Lunar Exploration Program is designed to be conducted in four phases.**

The first is simply reaching lunar orbit, a task completed by Chang'e 1 in 2007 and Chang'e 2 in 2010. The second is landing and roving on the Moon, as Chang'e 3 did in 2013 and Chang'e 4 did in 2019.

The third is collecting lunar samples from the near-side and sending them to Earth, a task for the future Chang'e 5 and Chang'e 6 missions.

The fourth phase consists of development of a robotic research station near the Moon's south pole.

Chang'e-4 mission

Chang'e-4 mission achieved **humanity's first soft landing on the far side of the Moon, on 3 January 2019.** This mission will attempt to determine the age and composition of an unexplored region of the Moon, as well as develop technologies required for the later stages of the program.

Objectives

An ancient collision event on the Moon left behind a very large crater, called the Aitken Basin, that is now about 13 km (8.1 mi) deep, and it is thought that the massive impactor likely exposed the deep lunar crust, and probably the mantle materials. If Chang'e 4 can find and study some of this material, it would get an unprecedented view into the Moon's internal structure and origins.

China has launched Chang'e-4, a first probe ever to explore the dark side of the Moon, marking another milestone in its ambitious space programme.

- The Moon is **tidally locked to Earth**, rotating at the same rate at which it orbits our planet, so the remote side is never visible from Earth. The probe, the Chang'e-4, is projected to make the first-ever soft landing on the far side of the Moon. Previous spacecraft have seen the Moon's far side, but none has landed on it.
- The Moon's **far side termed as 'South Pole Aitken Basin'** still remains a mystery among space scientists and by sending a probe there, China will outshine the US and USSR historical achievements .
- Chang'e 4 is the country's fourth mission in the series of lunar mission which is being named after the **Chinese Moon goddess**.
- The main problem faced by the Chinese team will be **difficulties in communication as they attempt to land on the Moon's other side**. China is anticipated for consideration of using options such as **radio telescopes for communicating in the absence of a transmitting medium**.

YUTU 2

China has named the **lunar rover**, successfully deployed to carry out a string of experiments on the far side of the Moon, as 'Yutu-2'. The rover's touchdown is part of China Chang'e-4 lunar probe.

Key facts

- The rover has been programmed to launch ground penetration radar that would **help map the Moon's inner structures**.
- It would **also analyse soil and rock samples for minerals, apart from activating a**

radio telescope to search for possible signals from deep space.

24. Hayabusa and Hayabusa-2

Hayabusa is an **asteroid sample-return mission** operated by the **Japanese Space Exploration Agency (JAXA)**.

In mid-September 2005, **Hayabusa landed on the asteroid Itokawa**, and managed to collect samples in the form of grains of asteroidal material. **It returned to Earth with the samples in June 2010, thereby becoming the first spacecraft to return asteroid samples to Earth for analysis.**

HAYABUSA-2

- It was **launched on 3 December 2014** and rendezvoused with **near-Earth asteroid Ryugu** on 27 June 2018 at 300 million km from Earth's surface.
- It is in the progression of asteroid surveying for a year and a half, leaving in December 2019, and returning to Earth in December 2020.
- Hayabusa-2 took numerous science payloads **for remote sensing, sampling, and four small rovers which will examine the asteroid surface so as to update the environmental and geological context of the samples collected.**

25. China's Artificial Moon Project

China is in the process of creating an “artificial moon” that would be bright **enough to replace the streetlights in the south-western city of Chengdu by 2020.**

- Chinese scientists intend for **sending three artificial Moons to space** in the **coming four years**, where **reflective material such as a mirror is estimated to orbit at 500 kilometres above the Earth** and **light up an area with a diameter of 10 to 80 kilometres**.
- There will be a **reflective coating on a artificial Moon** which can deflect sunlight back to Earth, akin to how the moon shines.
- The **enlightened satellite is said to be eight times brighter than the real Moon**.
- The three artificial moons would function alternately for significantly reducing infrastructural electricity consumption, especially at the time of winter. The illuminated satellite is intended to complement the moon at night.
- **Every year, light from the artificial moon in Chengdu covering 50 square kilometres could possibly save about 1.2 billion yuan (\$240 million) in electricity costs.**
- It could also be used to lighten up the areas experiencing power breakdown due to **natural disasters such as earthquakes**.

Note: The thought for the artificial human made moon began from a French artist who imagined hanging a necklace in the sky made of mirrors for lightening up the Paris streets at night. Russia tried to initiate a 25-metre “space mirror” but the project was suspended in the year 1999.