

NASA's Mars 2020 Mission

March 16, 2021

NASA's latest Mars rover, Perseverance, performed its first test drive on the Red Planet, covering a distance of about 6.5 metres across the Martian landscape, a "major milestone" before it began its science operations. According to NASA, the drive served as a mobility test to check out and calibrate every system, subsystem, and instrument on the Perseverance rover. Since its landing on Mars on 18 February 2021, the rover has undergone several routine checks, including a software update.

In news: NASA's Perseverance rover performs first test drive on Mars

Placing it in syllabus: Science & Technology

Dimensions

- Details of the Mission
- Its objectives
- Its Importance
- Goldilocks Zones and Biosignatures or Biomarkers
- Earlier Missions to Mars by NASA

Content:

Details of Mars 2020 Mission

- Mars 2020 is a Mars rover mission forming part of NASA's Mars Exploration Program
- The mission includes the rover **Perseverance** and the small robotic helicopter called **Ingenuity**.
- Mars 2020 was launched from Earth on an Atlas V launch vehicle on 30 July 2020 and confirmation of touch down in Jezero crater on Mars was received on 18 February 2021.
- On 5 March 2021, NASA named the landing site of the

rover Octavia E. Butler Landing.

MOXIE:

- Perseverance carries a unique instrument, **MOXIE or Mars Oxygen ISRU Experiment**: which for the first time will manufacture molecular oxygen on Mars using carbon dioxide from the carbon-dioxide-rich atmosphere.
- **ISRU means In Situ Resource Utilization**: or the use of local resources to meet human needs or requirements of the spacecraft.

Ingenuity Helicopter:

- If successful, Ingenuity will be the first ever helicopter to fly on Mars.
- This is the first time NASA will fly a helicopter on another planet or satellite.
- Ingenuity is a technology demonstration: the challenge, of course, is to fly the helicopter in the thin atmosphere of Mars

Its Objectives:

The Perseverance rover has four science objectives that support the Mars Exploration Program's science goals:

- **Looking for Habitability**: Identify past environments capable of supporting microbial life.
- **Seeking Biosignatures**: Seek signs of possible past microbial life in those habitable environments, particularly in special rocks known to preserve signs of life over time.
- **Caching Samples**: Collect core rock and "soil" samples and store them on the Martian surface.
- **Preparing for Humans**: Test oxygen production from the Martian atmosphere.

Its Importance

- All objectives of the mission address key astrobiology questions related to the potential of Mars as a place for life.
- The first three consider the possibility of past microbial life.
- Even if Perseverance does not discover any signs of past life, it paves the way for human life on Mars someday.

Solving. astronauts have to carry oxygen or water or rocket fuel for their journey for a two-year journey to Mars and back, the cost will be understandably excessive.

- If oxygen can be successfully extracted on Mars in some significant scale, this can have two direct advantages:
 - The oxygen can be used for human visitors to Mars, and
 - The oxygen can be used to manufacture rocket fuel for the return journey.
- Thus, if the technology demonstration is successful, NASA can easily scale up the oxygen generation rate per day for MOXIE by a hundred times: this would be of great use for a future human mission to Mars.

Developing Airborne Support:

- Like a drone on Earth, a Mars helicopter can help in rover drive planning and in fetching samples from locations that the rover cannot safely drive to.
- If this technology demonstration is successful, we will see a greater role for such helicopters in future missions.

Finding Life on Mars:

- Perseverance is the planned first step to bring back rock samples from Mars for analysis in sophisticated laboratories on Earth.

- The goal is to look for biosignatures: or signatures of present or past life.
- Perseverance will collect samples and a second rover mission will fly within a decade to help transport the rock samples back to Earth.

Goldilocks Zones

- The Goldilocks Zone or habitable zone is the area around a star where it is not too hot and not too cold for liquid water to exist on the surface of surrounding planets.
- The distance Earth orbits the Sun is just right for water to remain a liquid. This distance from the Sun is called the habitable zone, or the Goldilocks zone.
- Rocky exoplanets found in the habitable zones of their stars, are more likely targets for detecting liquid water on their surfaces.
- Life on Earth started in water, and water is a necessary ingredient for life

Biosignatures or Biomarkers

- A biosignature (sometimes called chemical fossil or molecular fossil) is any substance – such as an element, isotope, or molecule – or phenomenon that provides scientific evidence of past or present life.
- A biosignature is any characteristic, element, molecule, substance, or feature that can be used as evidence for past or present life.
- It also needs to be something that can't be made without the presence of life.
- Measurable attributes of life include its complex physical or chemical structures and its use of free energy and the production of biomass and wastes.
- A biosignature can provide evidence for living organisms outside the Earth and can be directly or indirectly detected by searching for their unique

byproducts.

Earlier Missions to Mars by NASA

NASA's incredible journey of driving on Mars started about 23 years ago, in 1997: when the Mars Pathfinder Mission with the Sojourner rover egressed on the Martian soil.

Mars Pathfinder:

- Launch: Dec. 4, 1996
- Mars Pathfinder, consisting of a lander and the Sojourner rover, returned an unprecedented amount of data as they explored an ancient flood plain in Mars' northern hemisphere known as Ares Vallis.

Mars Polar Lander/Deep Space 2:

- Launch: Jan. 3, 1999
- Mars Polar Lander was an ambitious mission to set a spacecraft down on the frigid terrain near the edge of Mars' south polar cap and dig for water ice with a robotic arm.
- Piggybacking on the lander were two small probes called Deep Space 2 designed to impact the Martian surface to test new technologies.

Mars Exploration Rovers (Spirit and Opportunity):

- Spirit Launch: Jun. 10, 2003; Mars Landing: Jan. 3, 2004
- Opportunity Launch: Jul. 7, 2003; Mars Landing: Jan. 24, 2004
- Two powerful Mars rovers are on the red planet.
- They have far greater mobility than the 1997 Mars Pathfinder rover. Each rover carries a sophisticated set of instruments to search for evidence of liquid water that may have been present in the planet's past.
- The rovers are identical to each other, but are exploring different regions of Mars.

- Spirit and Opportunity set a new paradigm of a long term robotic presence on Mars, lasting about 6 and 15 years, respectively.

Phoenix:

- Launch: Aug. 4, 2007
- The Phoenix Mars Lander successfully landed on the north polar region of Mars.
- Its mission is to dig up and analyze icy soil. The mission is the first chosen for NASA's Scout program, an initiative for smaller, lower-cost, completed spacecraft.
- Named for the resilient mythological bird, Phoenix uses a lander that was intended for use by 2001's Mars Surveyor lander prior to its cancellation.

Curiosity Rover:

- Curiosity is a car-sized Mars rover designed to explore the Gale crater on Mars as part of NASA's Mars Science Laboratory (MSL) mission.
- landed on Aeolis Palus inside Gale crater on Mars on 6 August 2012
- The rover's goals include an investigation of the Martian climate and geology, assessment of whether the selected field site inside Gale has ever offered environmental conditions favorable for microbial life (including investigation of the role of water), and planetary habitability studies in preparation for human exploration.
- In December 2012, Curiosity's two-year mission was extended indefinitely and still operational.

Mould your thought: Write a short note on NASA's Mars 2020 Mission.

Approach to the answer:

- Introduction
- Discuss the missions and its objectives
- Describe the scientific instruments carried
- Discuss the importance of the mission
- Conclusion