NASA's Mars 2020 Mission

Why in News

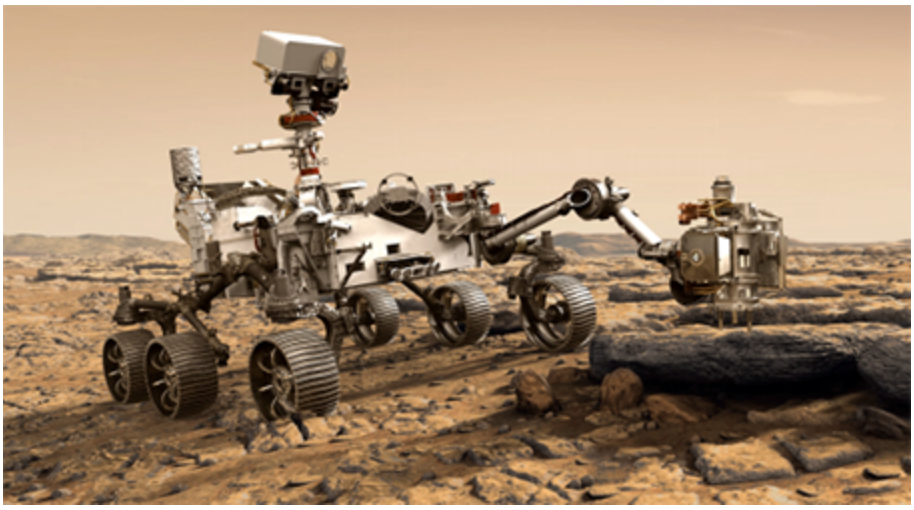
National Aeronautics and Space Administration (NASA's) Perseverance Rover has landed on Mars.

This was one of the most crucial aspects of the **Mars 2020 Mission.**

Key Points

- **About:**
  The mission is designed to better understand the **geology of Mars** and seek **signs of ancient life.**
- **Objectives:**
  - **Assess ancient habitability.**
  - **Demonstrate technology** for future robotic and human exploration.
- **Duration:** At least one Mars year (about 687 Earth days).
- **Mission Steps:**
  - **Collect:** Perseverance will collect rock and soil samples in cigar-sized tubes. The samples will be collected, the canisters will be sealed, and left on the ground.
  - **Fetch:** A **Mars Fetch Rover (provided by the European Space Agency)** will land, drive, and collect all samples from the different locations, and return to the lander.
  - **Transfer:** These samples will be transferred to the **Mars Ascent Vehicle** which will meet with an Orbiter.
  - **Return:** The **Orbiter** will carry the samples back to Earth.

Perseverance Rover



- **About:**
  - Perseverance is the most advanced, most expensive and most sophisticated mobile laboratory sent to Mars.
  - It is **different from previous missions** because it is capable of drilling and collecting core samples of the most promising rocks and soils, and setting them aside in a "cache" on the surface of Mars.
- **Launch:** 30th July, 2020
- **Landing:** 18th February, 2021
- **Landing Site:**

  Jezero Crater (an ancient river delta that has rocks and minerals that could only form in water).
- **Power Source:**

  A Multi-Mission Radioisotope Thermoelectric Generator (MMRTG) which converts heat from the natural **radioactive decay of plutonium (Plutonium Dioxide) into electricity.**

- **Instruments:** It carries seven instruments, two microphones and 23 cameras in total in order to conduct unprecedented science and test new technology on Mars. Few important **instruments** are:
    - **Mars Oxygen In-Situ Resource Utilisation Experiment (MOXIE):**
        - This will use power to produce oxygen using atmospheric carbon dioxide.
        - If successful, it can be scaled up to provide the **two very critical needs** of humans: oxygen for breathing, and rocket fuel for the trip back to Earth.
    - **Radar Imager for Mars' Subsurface Experiment (RIMFAX):**
      RIMFAX will provide high resolution mapping and also look for subsurface water on Mars.
    - **Mars Helicopter:**
      It is actually a small drone to test whether the helicopter can fly in the sparse atmosphere on Mars. The low density of the Martian atmosphere makes the odds of actually flying a helicopter or an aircraft on Mars very low.
    - **Mastcam-Z:**
      An advanced camera system with panoramic and stereoscopic imaging capability will help determine mineralogy.
    - **SuperCam:**
      It can provide imaging, chemical composition analysis, and mineralogy at a distance.
    - **Planetary Instrument for X-ray Lithochemistry (PIXL):**
      An X-ray fluorescence spectrometer and high-resolution imager that will provide capabilities that permit more detailed detection and analysis of chemical elements than ever before.
    - **Scanning Habitable Environments with Raman & Luminescence for Organics and Chemicals (SHERLOC):**
        - A spectrometer that will provide fine-scale imaging and uses an ultraviolet (UV) laser to map mineralogy and organic compounds.
        - SHERLOC will be the **first UV Raman spectrometer** to fly to the surface of Mars and will provide complementary measurements with other instruments in the payload.
    - **Mars Environmental Dynamics Analyzer (MEDA):**
      Sensors that will provide measurements of temperature, wind speed and direction, pressure, relative humidity, and dust size and shape.

Mars

- **Size and Distance:**
    - It is the **fourth planet from the Sun** and the **second-smallest planet** in the Solar System.
    - Mars is about half the size of Earth.

- **Similarity to the Earth (Orbit and Rotation):**
    - As Mars orbits the Sun, it completes one rotation every 24.6 hours, which is very similar to one day on Earth (23.9 hours).
    - Mars' axis of **rotation is tilted 25 degrees** with respect to the plane of its orbit around the Sun. This is similar with Earth, which has an axial tilt of 23.4 degrees.
    - Like Earth, Mars has distinct seasons, but they last longer than seasons on Earth since Mars takes longer to orbit the Sun (because it's farther away).
    - Martian days are called sols—short for **'solar day'.**
- **Surface:**
    - It has colors such as brown, gold and tan. The reason Mars looks reddish is due to oxidation or rusting of iron in the rocks, and dust of Mars. Hence it is also called **Red Planet.**
    - Mars has the **largest volcano in the solar system i.e. Olympus Mons.** It's three times taller than Earth's Mt. Everest with a base the size of the state of New Mexico.
- **Atmosphere:**
    Mars has a thin atmosphere made up mostly of carbon dioxide, nitrogen and argon gases.
- **Magnetosphere:**
    Mars has no magnetic field till date, but areas of the Martian crust in the southern hemisphere are highly magnetized, indicating traces of a magnetic field.
- **Moons:**
    Mars has two small moons, **Phobos and Deimos,** that may be captured asteroids.
- **Previous Mars Missions:**
    - The **Soviet Union in 1971** became the first country to carry out a Mars landing, Mars 3.
    - The second country to reach Mars's surface is the **United State of America (USA).** Since 1976, it has achieved 8 successful Mars landings, the latest being the **'InSight'** in 2019.
    - **European Space Agency** has been able to place their spacecraft in Mars's orbit through the **Mars Express Mission.**
- **India's Mars Orbiter Mission (MOM) or Mangalyaan:**
    - It was launched from the Satish Dhawan Space Centre in Andhra Pradesh by **Indian Space Research Organisation** in November 2013.
    - It was launched on board a PSLV C-25 rocket with aim of studying Martian surface and mineral composition as well as scan its atmosphere for methane (an indicator of life on Mars).

- **Reasons for Frequent Missions to Mars:** There are **two primary** reasons**:**
    - **Similar to Earth:**
        - First, Mars is a planet where life may have evolved in the past. Conditions on early Mars roughly around 4 billion years ago were very similar to that of Earth.
        - It had a thick atmosphere, which enabled the stability of water on the surface of Mars.
        - If indeed conditions on Mars were similar to those on Earth, there is a real possibility that microscopic life evolved on Mars.
    - **Most Suitable among Other Planets:**
        - Mars is the only planet that humans can visit or inhabit in the long term. Venus and Mercury have extreme temperatures – the average temperature is greater than 400 degree C. All planets in the outer solar system starting with Jupiter are made of gas – not silicates or rocks – and are very cold.
        - Mars is comparatively hospitable in terms of temperature, with an approximate range between 20 degrees C at the Equator to minus 125 degrees C at the poles.

Source: TH