

## NASA Perseverance [UPSC Science & Technology]

The NASA Perseverance Rover touched down on the surface of Mars in February 2021. The rover is part of NASA's Mars Exploration Program. This is an important topic for the [UPSC](#) science and technology topics and also as part of current affairs for IAS as well as other [government exams](#).

### Perseverance Rover

Perseverance is a Mars rover that was launched in July 2020 from Cape Canaveral Space Force Station, Florida, USA.

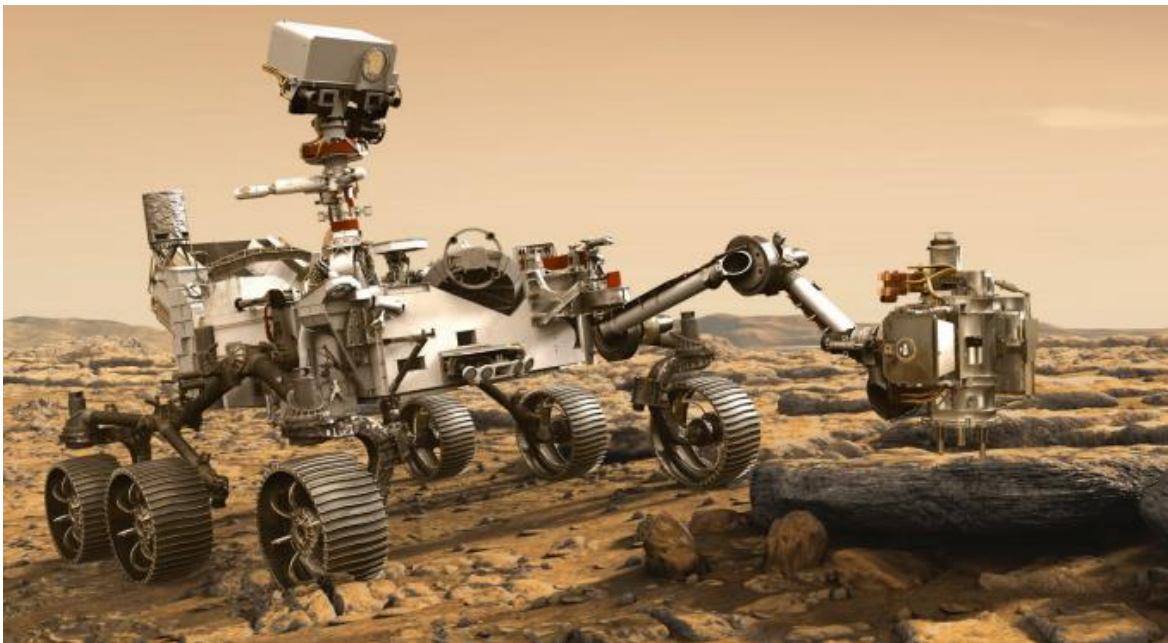


Image source: <https://mars.nasa.gov/>

- It is a part of the National Aeronautics and Space Administration's (NASA) Mars 2020 Mission.
- It is nicknamed 'Percy'.
- It is moderately upgraded when compared to NASA's previous Mars rover Curiosity.
- Perseverance is designed to better understand the geology of the red planet and seek signs of ancient life.
- The rover landed on Mars in Jezero Crater on Feb. 18, 2021 seven months after its launch. The landing site within the crater has been named Octavia E. Butler Landing by NASA.
  - The Jezero Crater is an ancient river delta containing rocks and minerals that could only form in water.
- **Mission's Key Objectives:**
  - Explore a geologically diverse landing site
  - Assess ancient habitability

- Seek signs of ancient life, particularly in special rocks known to preserve signs of life over time
  - Gather rock and soil samples that could be returned to Earth by a future NASA mission
  - Demonstrate technology for future robotic and human exploration.
- The rover will now spend at least one Mars year (two Earth years) exploring the landing site region on the planet.
- Perseverance also carried the **Ingenuity helicopter** (nicknamed Ginny).
  - Ingenuity is a technology demonstration to test the first powered flight on Mars. The first powered flight on another planet was made on April 19, 2021.

### Instruments on Perseverance Rover

There are seven instruments aboard the Perseverance. They are discussed below.

1. **Mastcam-Z**: It is an advanced camera system with panoramic and stereoscopic imaging capability with the ability to zoom. It will determine the Martian surface's mineralogy.
2. **SuperCam**: It is an instrument that can provide imaging, chemical composition analysis, and mineralogy at a distance.
3. **Planetary Instrument for X-ray Lithochemistry (PIXL)**: It is an X-ray fluorescence spectrometer and high-resolution imager. It will map the fine-scale elemental composition of materials on the surface of Mars.
4. **Scanning Habitable Environments with Raman & Luminescence for Organics and Chemicals (SHERLOC)**: It is a spectrometer that will provide fine-scale imaging and uses an ultraviolet laser to map mineralogy and organic compounds. SHERLOC will be the first UV Raman spectrometer to fly to the surface of Mars.
5. **Mars Oxygen In-Situ Resource Utilization Experiment (MOXIE)**: It is a technology demonstration that will produce oxygen from Martian atmospheric carbon dioxide.
  1. In April 2021, NASA reported that MOXIE had successfully converted some carbon dioxide from the Martian atmosphere into oxygen.
  2. This is the first time such a thing has happened on another planet.
  3. This will pave the way for the technology to be used by future astronauts on Mars to burn rocket fuel for returning to Earth.
6. **Mars Environmental Dynamics Analyzer (MEDA)**: It is a set of sensors that will provide measurements of temperature, wind speed and direction, pressure, relative humidity, and dust size and shape.
7. **Radar Imager for Mars' Subsurface Experiment (RIMFAX)**: It is a ground-penetrating radar that will provide centimetre-scale resolution of the geologic structure of the subsurface.

Besides the above, the rover has 23 cameras and 2 microphones in total.

### How is the Mars 2020 mission different from other missions?

Although there have been earlier missions to Mars that included orbiters, landers and rovers, the Mars 2020/Perseverance is the first time that the mission includes a drill that can collect core samples of

rocks and soils, and store them in a 'cache' on Martian surface. A future mission could return these samples to Earth.

Also, for the first time, the rover has directly recorded the sounds of the planet Mars.

### *Previous Missions to Mars*

There were several missions to Mars starting from 1960. Some of the important missions are mentioned in this section.

- The **first attempted mission to Mars** was in 1960 by the erstwhile Soviet Union. It was a flyby mission named 1M No.1, however, it failed to orbit the red planet.
- The **first successful flyby mission** was in 1965 by the USA's Mariner 4 mission.
- In 1971, USSR's Mars 2 became the first mission to get the **first impact on Mars**. Its lander became the first human-made object to reach the surface of Mars, although the landing system failed and the lander was lost.
- The **first lander on Mars** was achieved by USSR's Mars 3 mission, although contact was lost about a hundred seconds after landing.
- The **first successful orbiter of Mars** was achieved by the US in 1971 by its Mariner 9 mission. It was in orbit for 516 days.
- The USA in 1996 achieved the feat of **successfully operating a rover on another planet for the first time** through its Sojourner rover, part of the Mars Pathfinder mission.
- Mars Express is the **European Space Agency's first planetary mission**. Launched in 2003, the orbiter is currently operational.
- The [Mars Orbiter Mission](#) (MOM) or Mangalyaan was launched in 2013 by ISRO making it India's first interplanetary mission. Read more on MOM in the link.
- The Emirates Mars Mission is the UAE's Mars mission which was launched in 2020. Its Hope orbiter is currently operational.
- China's Mars mission is named Tianwen-1 and its orbiter entered the Martian orbit in February 2021. Its lander and rover are expected to land on Mars in May 2021.

### **Why so many missions to Mars?**

There are two chief reasons why there are several missions to Mars.

1. The first reason is that it is the planet most similar to our own Earth. Since conditions on the planet around 4 billion years ago were quite similar to what was there on Earth, it is probable that microscopic life may have evolved there in the past. Mars had a thick atmosphere which facilitated the stability of water on its surface.
2. Compared to other planets, Mars is most suitable for life apart from Earth. It is relatively hospitable in terms of temperature. The average temperature ranges from 20 degrees Celsius at the Equator to -125 degrees Celsius at the poles. Hence, it is the only planet that we can visit or inhabit in the long term. The average temperatures in Mercury and Venus exceed 400-degree celsius. And, the outer planets are all extremely cold.

## Facts about Planet Mars

Mars is the fourth planet from the Sun in the Solar System.

- It is 142 million miles from the Sun.
- It is the second-smallest planet after Mercury and was named after the Roman god of war.
- The distinct reddish appearance of Mars is because of iron oxide prevalent on its surface.
- The minimum distance from Earth to Mars is about 33.9 million miles (54.6 million kilometres). The average distance is about 225 million km.
- Length of one year on Mars is 687 Earth Days.
- Length of one day on Mars is 24 hours 37 minutes.
- Its axis is tilted at 25 degrees.
- Gravity on Mars is only 0.375 that of Earth.
- The average temperature on Mars is minus 60 degrees Celsius.
- The Martian atmosphere is chiefly composed of carbon dioxide (96%) and some water vapour.
- To compare the volumes of Mars and Earth, it would take six of Mars to fill the volume of Earth!
- Mars is about one-tenth the mass of Earth.
- Mars has two moons, Phobos and Deimos.
- The highest known mountain and largest volcano on any planet in the Solar System is on Mars and it is called Olympus Mons. It is three times taller than Mount Everest.

The following image shows both Earth and Mars.



Image source: <https://mars.nasa.gov/>