# NASA's Mars 2020 Perseverance Rover - Why is Mars so interesting?

## What is the issue?

- NASA's Mars 2020 Perseverance Rover touched down on the Martian surface.
- In this context, here is a look at Perseverance Rover's plan and also why Mars remains so interesting for scientific experiments and exploration.

## How had Mars Science been in the past?

- **1960s** - From the time of the first generation missions in the 1960s, the world has come a very long way in understanding Mars.
- The Viking missions in the mid-seventies carried out the first chemical analysis of Martian soil.
    - It also did four biology experiments to detect biological activity.
- The experiments did not yield any conclusive evidence of life.
- **1980s** - In the early 1980s, scientists hypothesised that certain meteorites might have a source region in Mars, in contrast to the asteroid belt.
    - This was based on mineralogic composition and rock texture.
- In 1984, a study showed that the isotopic composition of rare gases (Xenon, Krypton, Neon and Argon) matched the isotopic ratios of the Martian atmosphere measured by the Viking spacecraft.
- This discovery provided a way for geochemists to study Martian samples.
- It provided a huge boost to the understanding of the geochemical evolution of Mars.
- **2000s** - Mars was considered to be a dry planet in the 20th century.
- This changed in 2001, when the Gamma Ray Spectrometer on board the Mars Odyssey spacecraft detected a fascinating hydrogen signature.
    - It seemed to indicate the presence of water ice.
- But there was ambiguity, as hydrogen can be part of many other compounds as well, including organic compounds.
- To test for the presence of water, NASA sent a spacecraft to land near the Martian South Pole in 2007.
- The spacecraft studied the soil around the lander with its robotic arm.
- It was able to establish, without any ambiguity, the presence of water on Mars for the first time.

- The Curiosity rover carries an instrument called SAM (or Sample Analysis at Mars).
- It contains a suite of spectrometers with the goal of detecting organic compounds on Mars.
- SAM has a mass spectrometer that can measure not just the elements, but the isotopes as well.
- This instrument has made the fascinating discovery of large chain organic compounds on Mars.
- It is not known how these organics form on Mars.
    - The process would likely be inanimate.
    - But there is a possibility that such complex molecules were formed by processes associated with life.
- Mars Insight is creating history right now, by monitoring seismic activity and heat flow on Mars.
    - This will help understand the composition of the Martian interior.

## Why is Mars so interesting to scientists?

- **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.
- **Second**, 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.

## Why is Perseverance Rover significant?

- Perseverance addresses both the critical themes around Mars:
    1. the search for life
    2. a human mission to Mars
- It is not just another Rover Mission but the most advanced, most expensive and most sophisticated mobile laboratory sent to Mars.
- The results of the experiments on Perseverance will likely define the next

couple of decades of Mars exploration.
- It will determine the course of search for life and a future manned mission to Mars.

## What all will the Perseverance Rover accomplish?

- **Sample Return Mission -** Perseverance is the first step in a multi-step project to bring samples back from Mars.
- The study of the returned rock samples will hopefully provide a decisive answer on whether life existed on Mars in the past.
- Here are the steps in the Sample Return:
    - Collect rock and soil samples in 43 cigar-sized tubes - samples will be collected, the canisters will be sealed, and left on the ground
    - Mars Fetch Rover (provided by the European Space Agency) - land, drive, and collect all samples from different locations, and return to the lander
    - The Fetch Rover will then transfer the canisters to the Ascent Vehicle.
    - The Mars Ascent Vehicle will meet with an Orbiter after which the Orbiter will carry the samples back to Earth.
- This long-term project is called MSR or Mars Sample Return.
- MSR will revolutionise our understanding of the evolutionary history of Mars.
- If MSR is successfully executed, it will tell a reasonable answer of whether there was microscopic life on Mars.
- But MSR does have its risks.
    - If one of the components fails, like the Fetch Rover or the Mars Ascent Vehicle, MSR is doomed.
    - A hidden risk is strategic. At the cost of MSR, there could be 5-10 spacecraft missions to different parts of the solar system.
- **Producing oxygen on Mars**: A technology and infrastructure in place to manufacture oxygen on Mars using raw materials available on Mars, is crucial to make a human mission to Mars at reasonable cost.
- Perseverance will have an instrument – MOXIE, or Mars Oxygen In-Situ Resource Utilisation Experiment.
- This will use 300 watts of power to produce about 10 grams of oxygen using atmospheric carbon dioxide.
- Should this experiment be successful, MOXIE can be scaled up by a factor of 100 to provide the two very critical needs of humans:
    i. oxygen for breathing
    ii. rocket fuel for the trip back to Earth

- **Looking for underground water on Mars**: Perseverance will carry the Radar Imager for Mars' Subsurface Experiment (RIMFAX).
- RIMFAX will provide high resolution mapping of the subsurface structure at

the landing site.

- The instrument will also look for subsurface water on Mars.
    - If found, it would greatly help the case for a human mission or the cause of a human settlement on Mars.
- **Testing a helicopter to fly on Mars**: The Mars Helicopter is really a small drone.
- It is a technology demonstration experiment, 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.

**Source: The Indian Express**