Mars Exploration Missions

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Manifest Pedagogy

Missions on Mars are on since six decades. The explorations of NASA and ISRO are significant. Missions like Opportunity have contributed largely in interplanetary studies. The orbiter, lander and rover missions are to be listed. Time and again the prelims questions have come on Mars explorations.

In news

Opportunity rover has stopped communicating with Earth after 15 years of service.

Placing it in the syllabus

Awareness in the fields of Space

Static dimensions

1. NASA’s and ISRO’s Missions on Mars

Current dimensions

1. Operational missions on Mars
2. Findings on Mars

Content

NASA’s Mars Rover Missions

Spirit and Opportunity:

Spirit and Opportunity landed on Mars January 3 and January 24, 2004 . Both rovers lived well beyond their planned 90-day missions. Opportunity worked nearly 15 years on Mars and broke

the driving record for putting the most miles on the odometer.

Goals of Rover Mission:

1. To search for and characterize a wide range of rocks and soils for clues to past water activity on Mars.
2. The rovers were targeted to sites on opposite sides of Mars that looked like they were affected by liquid water in the past.

Findings regarding the evidence of life:

Spirit and Opportunity, have both found dramatic evidence that:

- Long ago Mars was wetter.
- Conditions at Mars could have sustained microbial life, if any existed.

Other findings:

Salty water, Warmer climates, Watery past, Ancient volcano, Past flowing waters and right conditions for life.

With data from the rovers, mission scientists have reconstructed an ancient past when Mars was awash in water. Spirit and Opportunity each found evidence for past wet conditions that possibly could have supported microbial life.

Landed sites

- Opportunity landed at Meridiani Planum, a possible former lake in a giant impact crater.
- Spirit landed at Gusev Crater, a place where mineral deposits suggested that Mars had a wet history.

Movement of the rovers/exploration

- Each rover was created to be the mechanical equivalent of a geologist walking from place to place.
- The mast-mounted cameras provided 360-degree two-eyed,

humanlike views of the terrain.

- The robotic arm moves like a human arm with an elbow and wrist and can place instruments directly up against rock and soil targets of interest.
- The mechanical “hand” of the arm holds a microscopic camera that serves the same purpose as a geologist’s handheld magnifying lens.
- The Rock Abrasion Tool is like a geologist’s rock hammer that exposes the insides of rocks.

Instruments on the Mars Exploration Rovers

1. **Panoramic camera** for determining the mineralogy, texture, and structure of the local terrain.
2. **Miniature Thermal Emission Spectrometer** for identifying promising rocks and soils for closer examination and for determining the processes that formed Martian rocks.
3. **Mossbauer Spectrometer** for close-up investigations of the mineralogy of iron-bearing rocks and soils.
4. **Alpha Practice X-Ray Spectrometer** for close-up analysis of the abundances of elements that make up rocks and soils.
5. **Magnets** for collecting magnetic dust particles.
6. **Microscopic Imager** for obtaining close-up, high-resolution images of rocks and soils.
7. **Rock Abrasion Tool** for removing dusty and weathered rock surfaces and exposing fresh material for examination by instruments onboard.

Other rovers on Mars

- Another NASA rover called **Curiosity**, which arrived on Mars in 2012, continues its work on the Martian surface, collecting soil samples to analyze them for signs of organic compounds.
- NASA’s **InSight spacecraft,** the first robotic lander designed to study the deep interior of a distant world, touched down safely on the surface of Mars in November,

with instruments to detect planetary seismic rumblings never measured anywhere but Earth.
- InSight and the next Mars rover mission, scheduled for 2020, are both seen as precursors for eventual human exploration of Mars.

Other missions on Mars:

NASA's MAVEN

- Mars Atmosphere and Volatile Evolution (MAVEN) mission was developed to study the Martian atmosphere while orbiting Mars. it was launched in 2013.
- In September 2014, MAVEN reached Mars and was inserted into an areocentric elliptic orbit 6,200 km (3,900 mi) by 150 km (93 mi) above the planet's surface.
- NASA announced that data from MAVEN shows that the deterioration of Mars' atmosphere increases significantly during solar storms.

Mission Goals include determining how the planet's atmosphere and water, presumed to have once been substantial, were lost over time.

Four scientific objectives of MAVEN

1. Determine the role that loss of volatiles to space from the Martian atmosphere has played through time.
2. Determine the current state of the upper atmosphere, ionosphere, and interactions with the solar wind.
3. Determine the current rates of escape of neutral gases and ions to space and the processes controlling them.
4. Determine the ratios of stable isotopes in the Martian atmosphere.

ISRO's MOM

- The Mars Orbiter Mission (MOM), also called Mangalyaan, It was launched on 5 November 2013 by the Indian Space Research Organisation(ISRO).

- Marking India’s first venture into the interplanetary space, MOM will explore and observe Mars surface features, morphology, mineralogy and the Martian atmosphere.
- Further, a specific search for methane in the Martian atmosphere will provide information about the possibility or the past existence of life on the planet.
- It is India’s first interplanetary mission and it made it the fourth space agency to reach Mars, after Roscosmos, NASA, and the European Space Agency.
- India is the first Asian nation to reach Mars orbit, and the first nation in the world to do so in its first attempt.

Mission objectives

- The primary objective of the mission is to develop the technologies required for designing, planning, management and operations of an interplanetary mission.
- The secondary objective is to explore Mars’ surface features, morphology, mineralogy and Martian atmosphere using indigenous scientific instruments.

Scientific objectives

The scientific objectives deal with the following major aspects:

- Exploration of Mars surface features by studying the morphology, topography and mineralogy
- Study the constituents of Martian atmosphere including methane and CO2 using remote sensing techniques
- Study the dynamics of the upper atmosphere of Mars, effects of solar wind and radiation and the escape of volatiles to outer space

The mission would also provide multiple opportunities to observe the Martian moon Phobos and also offer an opportunity to identify and re-estimate the orbits of asteroids seen

during the Martian Transfer Trajectory.