DAILY CURRENT AFFAIRS 25-12-2025

GS-1

1. **India's Largest Circular Stone Labyrinth**

GS-3

2. **Rapid Financing Instrument (RFI)**
3. **Mars Atmosphere and Volatile Evolution (MAVEN) Spacecraft**
4. **Micrometeoroids and Orbital Debris (MMOD)**
5. **Yellowstone National Park**

India's Largest Circular Stone Labyrinth

Syllabus: GS-1; History of the world: Early cultural contacts (India–Roman world)

Context

- Archaeologists have recently discovered India's largest circular stone labyrinth in the Boramani grasslands of Solapur, Maharashtra, dating back nearly 2,000 years to the Satavahana period and linked to Indo-Roman trade interactions.

About India's Largest Circular Stone Labyrinth

- Located in **Boramani grasslands, Solapur (Maharashtra)**, it measures about **50 ft × 50 ft** and consists of **15 concentric stone circles**, the highest recorded in India.
- The structure follows a **unicursal path** guiding movement inward to a tightly coiled **central spiral**, reflecting high geometric precision and symbolic intent.
- It dates to around **2nd century CE**, associated with the **Satavahana dynasty**, indicating cultural exchange during **Indo-Roman trade**.
- Soil deposition between stone rings suggests the site remained **undisturbed for centuries**, preserving its original layout.
- The design resembles **Mediterranean (Roman-era) labyrinths**, while the central spiral aligns with the Indian concept of **Chakravyūha** from the *Mahabharata*.
- Earlier, the largest circular labyrinth in India had **11 circuits**; a larger **square labyrinth exists at Gedimedu (Tamil Nadu)**, but this is the **largest circular** one.

Chakravyūha

- A **complex military formation** described in the *Mahabharata*.
- Designed as **multiple concentric defensive layers** to entrap and overwhelm enemies.
- Symbolically associated with **strategy, encirclement, and controlled movement**.

Mazes vs. Labyrinths

- **Maze**: Multicursal; has multiple paths, choices, dead ends; puzzle-like.
- **Labyrinth**: Unicursal; a **single continuous path** leading to the centre; no wrong turns.
- Labyrinths are meant for **symbolic, ritualistic, or meditative purposes**, not problem-solving.
- Labyrinth designs date back **over 4,000 years**, found in **Roman mosaics, caves, medieval churches, and turf carvings**.

Rapid Financing Instrument (RFI)

Syllabus: GS-3; Indian Economy, International Financial Institutions

Context

Recently, the **International Monetary Fund (IMF)** approved emergency funding of **USD 206 million** under its **Rapid Financing Instrument (RFI)** to help Sri Lanka address urgent needs arising from **Cyclone Ditwah**.

About Rapid Financing Instrument

- It provides **quick financial assistance** to IMF member countries facing urgent **balance of payments** needs.
- It operates under the **General Resources Account (GRA)**.
- It is used during crises such as natural disasters or economic shocks.

Types of Rapid Financing Instrument

1. **Regular Window**
    - For balance of payments needs due to domestic instability, exogenous shocks or fragility

- Access:
  - Up to **50% of quota per year**
  - Up to **100% of quota cumulatively**

2. **Large Natural Disaster Window**
   - For disasters causing damage **≥ 20% of GDP**
   - Access:
     - Up to **80% of quota per year**
     - Up to **133.33% of quota cumulatively**

Conditionality

- No ex-post programme-based conditionality or reviews
- Prior actions may apply
- Recipient country's policies must address underlying balance of payments problems

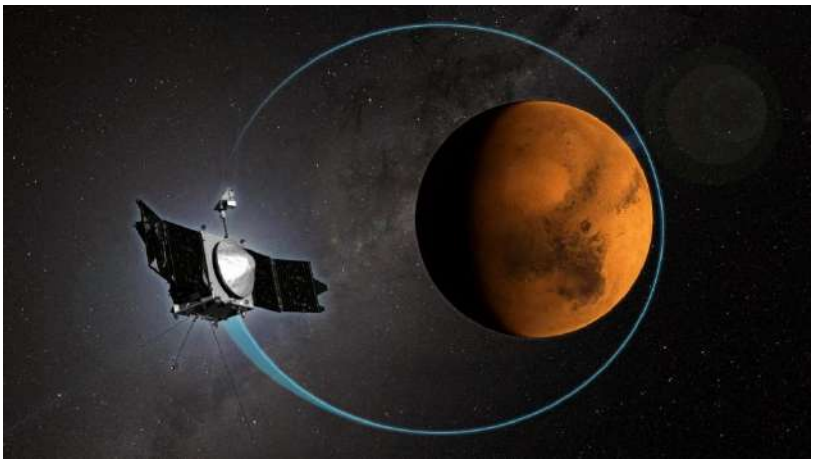
Mars Atmosphere and Volatile Evolution (MAVEN) Spacecraft

Syllabus: GS-3; Science and Technology – Space.

Context:

- **NASA** has **temporarily lost contact with its MAVEN spacecraft**, and engineers are attempting to **re-establish communication**.
- MAVEN has been operating around Mars for over a decade under **extended missions**, far beyond its original design life.

About MAVEN (Mars Atmosphere and Volatile EvolutioN)



Basic Details

- **Agency:** NASA
- **Mission Type:** First mission dedicated to **Mars' upper atmosphere**
- **Launch Year:** 2013
- **Launch Site:** Cape Canaveral Air Force Station, Florida
- **Mars Orbit Insertion:21 September 2014**
- **Nominal Mission:** 1 year (currently on extended mission)

Mission Objective

- To understand **how Mars lost its atmosphere and water** over billions of years.
- To explain the planet's transition from a **potentially habitable world** to a **cold, arid desert**.

Technical Features

Launch & Orbit

- **Launch Vehicle:** Atlas V-401
- **Orbit Type:** Highly **elliptical orbit**
    - Altitude range: **~150 km to 6,200 km**
    - Includes periodic **"deep dips"** into the upper atmosphere for direct sampling

Scientific Payload

- **Total Payload Mass:** ~65 kg (143 pounds)
- **Instruments:** 8 scientific instruments, including:
    - **Imaging Ultraviolet Spectrograph (IUVS):**
        - Measures ultraviolet emissions
        - Detects gases escaping from Mars' atmosphere
    - **Magnetometer:**
        - Studies interaction between solar wind and Martian atmosphere
    - **Neutral Gas & Ion Mass Spectrometer:**
        - Determines composition of escaping atmospheric particles

Communications

- **High-gain antenna** for Earth communication
- **Electra UHF package** to relay data from Mars rovers and landers

Key Scientific Discoveries

- **Atmospheric Escape:**
  - Direct evidence of **oxygen, carbon, and hydrogen** atoms escaping into space.
- **Role of Solar Wind:**
  - Mars loses atmosphere mainly due to **solar wind stripping**, as it lacks a global magnetic field.
- **Seasonal Variation:**
  - Atmospheric loss is **~10 times higher** when Mars is closer to the Sun.
- **Martian Auroras:**
  - Discovery of **planet-wide auroras**, unlike Earth's polar auroras.
- **Upper Atmosphere Winds:**
  - Produced the **first global wind map** of Mars' upper atmosphere.

Quick Comparison: India's Mars Orbiter Mission (MOM)

Mars Orbiter Mission / Mangalyaan

- **Launch Date:** 5 November 2013
- **Agency:** ISRO
- **Launch Vehicle:** PSLV-XL (C25)
- **Significance:**
  - India became the **first nation to reach Mars on its maiden attempt**.
- **Primary Objective:**
  - **Technology demonstration** and limited scientific observations of:
    - Martian surface features
    - Morphology and mineralogy

- Martian atmosphere

Micrometeoroids and Orbital Debris (MMOD)

Syllabus: GS-3: Science and Technology – Space.

Context:

Damage to a window of China's *Shenzhou-20* crewed spacecraft due to orbital debris has renewed global concerns over astronaut and spacecraft safety from MMOD.

What is MMOD?

- **Micrometeoroids and Orbital Debris (MMOD)** is a **combined threat** from:
  - **Micrometeoroids**: Naturally occurring tiny particles in space.
  - **Orbital debris**: Human-made objects orbiting Earth.
- Despite small size, **extreme velocities** make them capable of **severely damaging or destroying spacecraft**.

Location

- **Orbital Debris**
  - Concentrated mainly in **Low Earth Orbit (LEO)**: *200–2,000 km* altitude.
- **Micrometeoroids**
  - Present throughout **interplanetary space**.
  - Slightly higher density near Earth due to **gravitational attraction**.

Formation

- **Micrometeoroids**
  - Result from **asteroid belt collisions** and **cometary debris**.

- Enter Earth's vicinity at very high speeds.

- **Orbital Debris**
  - Sources include:
    - Defunct satellites
    - Exploded rocket stages
    - Accidental satellite collisions
    - **Anti-Satellite (ASAT) weapon tests**
- **Cascade Effect (Kessler Syndrome)**
  - Collisions generate more fragments, leading to a **self-sustaining chain reaction** of debris.

Key Features

- **Extremely high velocity**
  - Micrometeoroids: *11–72 km/s*
  - Orbital debris: *~10 km/s*
  - → Even millimetre-sized particles can be lethal.
- **Huge population**
  - **~34,000 objects** (>10 cm) are tracked.
  - **Hundreds of millions** of smaller fragments remain untrackable.
- **Highly directional risk**
  - Maximum danger on **forward-facing spacecraft surfaces**.
- **Difficult to detect**
  - Most MMOD particles are too small for real-time tracking.
  - Reliance on **probabilistic risk modelling**.
- **Long persistence**
  - Debris can remain in orbit for **decades to centuries**, especially in higher LEO.

Implications

- **Threat to astronaut safety**
  - Even tiny debris can cause **catastrophic damage** to crewed spacecraft and space stations.
- **Risk to satellites and missions**
  - Potential disruption of:
    - Communication
    - Navigation (GNSS)
    - Earth observation and weather forecasting
- **Rising operational costs**
  - Frequent **collision-avoidance manoeuvres** consume fuel and reduce mission life.
- **Barrier to future space exploration**
  - Uncontrolled debris growth may render some orbits **unsafe or unusable**.
- **Need for global governance**
  - Existing **UN space debris mitigation guidelines are non-binding**.
  - Highlights gaps in **enforceable international space law**.

Yellowstone National Park

Syllabus: GS-3: Environment – Protected Areas – National Parks.

Context:

- The **US Geological Survey (USGS)** released footage showing **mud eruptions from the Black Diamond Pool**, indicating **renewed hydrothermal activity** in Yellowstone.

About Yellowstone National Park

What is it?

- World's first national park.

- Globally renowned for **geothermal activity**, **volcanic landscape**, **wildlife**, and **intact ecosystems**.
- Hosts **~50% of the world's known hydrothermal features** (geysers, hot springs, mud pools).

Location (Mapping Focus)

- Northwestern United States
- Spans **Wyoming (major part)**, **Montana**, and **Idaho**
- Area: **~8,992 sq km (3,472 sq miles)**

Historical Background

- **Established:** March 1, 1872 (by U.S. Congress)
- **Global First:** First national park in the world
- **UNESCO Status:**
  - Biosphere Reserve (1976)
  - World Heritage Site (1978)

Key Physical & Geological Features

1. Geothermal Dominance

- **>10,000 hydrothermal features**
- **>300 geysers**

- *Old Faithful*
- *Steamboat Geyser* (world's tallest active geyser)

2. Volcanic Hotspot

- Lies above a **mantle hotspot**
- Presence of **magma chambers** fuels:
  - Geysers
  - Hot springs
  - Fumaroles
  - Mud pots
- Part of the **Yellowstone Caldera system**

3. Seismic Activity

- Experiences **hundreds to thousands of minor earthquakes annually**
- Indicates **active tectonic and magmatic processes**

4. Distinct Physical Landscape

- **Volcanic plateaus**
- Mountain ranges:
  - Absaroka Range
  - Gallatin Range
  - Teton Range
- **Obsidian cliffs**, lava flows, deep canyons

5. Hydrology

- **Yellowstone Lake**:
  - Largest **high-altitude lake** in North America
- **Grand Canyon of the Yellowstone River**

6. Rich Biodiversity

- One of the world's most intact **temperate ecosystems**
- Iconic fauna:

- Bison
- Grizzly bears
- Wolves
- Elk (Wapiti)

Significance

Scientific Importance

- Acts as a **global natural laboratory** for:
  - Volcanology
  - Hydrothermal systems
  - Seismology

Environmental & Conservation Significance

- Benchmark for global national park conservation model
- Large-scale **ecosystem preservation**

Climate & Ecological Research

- Helps study:
  - Ecosystem resilience
  - Climate change impacts
  - Wildlife population dynamics