PRELIMS EDGE – 2025 – 04/11/2024

Coronal Mass Ejections

Context: India's solar mission Aditya-L1 recently captured images of the Sun and it's Coronal Mass Ejections (CMEs)
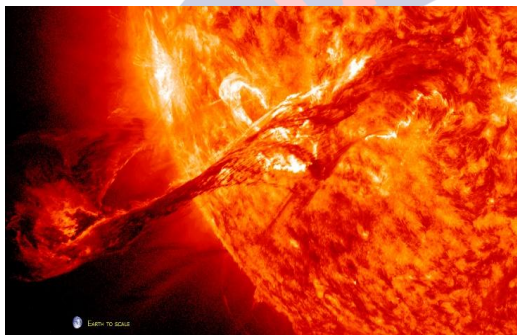
About Coronal Mass Ejections

- A coronal mass ejection (CME) is a large **expulsion of plasma and magnetic fields from the Sun's corona into space**
- CMEs were discovered in 1971 and established their importance in solar-terrestrial relations later in the 1980s.
- It consists of **massive clouds of solar plasma and magnetic field lines**.
- It typically accompanies **solar flares** and filament eruptions.
- The frequency of CMEs varies with the **11-year solar cycle**, with about one a week observed **during solar minimum** and an average of two to three CMEs per day observed near solar maximum
- They travel at thousands of km per hour.

- They can lead to **geomagnetic storms, aurorae, and in extreme cases, damage to electrical power grids.**
- Not all CMEs interact with Earth, but those that do can cause disruptions to satellite communications and power grids.
- Halo CMEs are Earth-directed CMEs visible as rings in white-light coronagraph observations.

About Aditya-L1:

- Aditya-L1 mission is **India's first** space mission to observe the Sun.
- It was launched on September 2nd 2023 to **observe the Sun and the solar corona from the L1 Point.**
- Aditya is placed in **L1 Halo orbit** which is about 1.5 million km from the Earth.
- The orbit allows the mission to look at the Sun continuously.
- L1 refers to Lagrange Point 1, one of 5 points in the orbital plane of the Earth-Sun system.
- **Lagrange Points** are positions in space where the gravitational forces of a two-body system like the Sun and Earth balance out each other, allowing a spacecraft to "hover" in a stable orbit.

Source: First science result from Aditya L1, ISRO's sun mission, is out (The Hindu)

Terms in News

Su-30MKI

- The Sukhoi Su-30MKI is a **4th Generation two-seater, twinjet multirole air superiority fighter.**
- It is developed by **Russian** aircraft manufacturer Sukhoi and built under license by **India's Hindustan Aeronautics Limited (HAL)** for the Indian Air Force (IAF).
- A variant of the Sukhoi Su-30, it is a heavy, all-weather, long-range fighter.
- The Su-30MKI is a highly integrated twin-finned aircraft.
- The airframe is constructed of titanium and high-strength Aluminium alloy
- The Su-30MKI has a range of 3,000 km with internal fuel which ensures a 3.75-hour combat mission.
- The air refueling system increases the flight duration up to 10 hours with a range of 3,000 km combat radius.
- The Su-30MKI fleet of IAF was fitted with air-launched version of **BrahMos** supersonic cruise missiles

The Gompertz model

- Indian researchers have developed a predictive model based on the Gompertz Model **to estimate a newborn's birth weight using routine pregnancy scans.**

- It is a mathematical model developed by English mathematician Benjamin Gompertz in the early 19th century.
- It was originally designed to model **population growth** in a constrained environment, such as a specific geographic region.
- The model uses an S-shaped (sigmoid) curve to represent growth patterns that start slowly, accelerate, and then slow again as they approach a plateau.

Applications:

- **Biology:** The Gompertz Model is used to study tumor growth and cell population dynamics, reflecting constrained growth in biological systems.
- **Epidemiology:** Applied in predicting the spread of infectious diseases like COVID-19, capturing how transmission rates slow with interventions.
- **Ecology**: Useful for modelling species population growth in habitats with limited resources, aiding conservation and ecosystem management.
- **Healthcare:** Recently adapted to predict fetal birth weight, helping identify potential risks associated with low or high birth weight.
- **Aging Research:** Employed to analyze mortality rates and lifespan patterns, contributing to studies on aging and longevity.

Analog Space Mission

- The Indian Space Research Organisation **(ISRO)** has launched India's first analog space mission in Leh, Ladakh.

About Analog Space Mission:

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- Analog space missions are field tests in locations on Earth that have physical similarities to the extreme space environments and play a significant role in problem solving for spaceflight research

- **Objective:** Simulate interplanetary habitat conditions to assess the feasibility of a sustainable extraterrestrial base.

- **Significance of location**: Ladakh's isolation, dry climate, and high-altitude, barren terrain provide Mars- and Moon-like conditions, making it ideal for analog simulations.

- **Collaborative effort:** Led by ISRO's Human Spaceflight Centre with partners including AAKA Space Studio, the University of Ladakh, and IIT Bombay.

- **Key benefits:** Supports Gaganyaan and other future space missions by testing life-support technologies, habitat feasibility, communication systems, and behavior in isolated conditions.

- **International context:** Analog missions, also conducted by NASA, simulate space conditions on Earth to evaluate human and robotic responses, technology, and operational dynamics essential for deep-space missions.

Places in News

South Lhonak Lake

- Located at 17100 feet above sea level in Sikkim, It is a **glacial moraine dammed lake** formed due to the melting of the Lhonak glacier.

- It is one of the **fastest expanding lakes** in the **Sikkim Himalaya region**, and was a potentially hazardous lakes susceptible to glacial lake outburst floods (GLOF).

- Since 1977, the South Lhonak Lake, a glacial lake in Sikkim has expanded significantly, growing from 17 hectares to 167 hectares by 2023.

- When a glacier melts and retreats, the hollow left behind often fills with water, creating a glacial lake.

- As glacial lakes grow larger, they become more dangerous because glacial lakes are mostly dammed by unstable ice or sediment.

- In case the boundary around them breaks, huge amounts of water is released causing catastrophic floods downstream. This is **called glacial lake outburst floods** (GLOF).

- GLOF can be triggered by several reasons, including earthquakes, heavy rains and ice avalanches.

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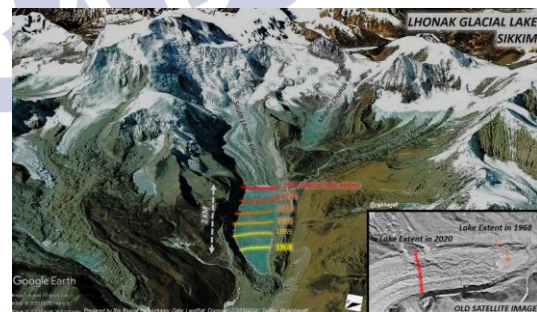
Practice Questions

Q1 : Consider the following statements regarding Coronal mass Ejections

1. A coronal mass ejection (CME) is a large expulsion of plasma and magnetic fields from the Sun's corona into space
2. The frequency of CMEs varies with the 11-year solar cycle
3. They can lead to geomagnetic storms, aurorae, and in extreme cases, damage to electrical power grids.

How many of the above statements are in correct?

    A. Only One
    B. Only Two
    C. All of the Above
    D. None of the above

Q2: Which among the following is Indian Air Force's 4th Generation air superiority fighter Jet?

    A. HAL HF-24 Marut
    B. HAL AMCA
    C. LCA Tejas
    D. SU-30 MKI

Q3: How many of the following have potential applications of The Gompertz model?

1. To study population growth in a constrained environment
2. To study tumor growth and cell population dynamics
3. For modelling species population growth in habitats with limited resources
4. To predict fetal birth weight

Select the correct option from the following?

    A. Only Two
    B. Only Three
    C. All of the above
    D. None of the above

Q4 : Consider the following statements regarding Space Analogue Missions

1. They are field tests in locations on Earth that have physical similarities to the extreme space environments.
2. They aim to simulate interplanetary habitat conditions to assess the feasibility of a sustainable extraterrestrial base.
3. The ISRO has launched India's first analog space mission in Sagar Island.

How many of the above statements are incorrect?

    A. Only One
    B. Only Two
    C. All of the above
    D. None of the above

Q5: The South Lhonak Lake is located at which of the following state?

    A. Sikkim
    B. Ladakh
    C. Himachal Pradesh
    D. Arunachal Pradesh

Answers

1. C
2. D
3. C
4. A
5. A