



# Telescope in Cosmic World

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## Why in News?

An [Extremely Large Telescope \(ELT\)](#) is under construction atop the **Cerro Armazones Mountain** in the [Atacama Desert](#) in **Chile**.

## What are Telescopes?

- **About:** A telescope is an **instrument** that astronomers use to observe faraway objects.
  - It is a common **misconception** that telescopes are designed to make astronomical objects **appear larger**. Instead their primary function is to **enhance the brightness** of celestial objects, measured by their **light-gathering power**.
    - The **aperture** size determines how much light can be gathered. A **small reflecting telescope** (0.07m aperture) gathers **118.5 times more light** than the human eye.
- **Types of Telescopes:**
  - **Reflecting Telescope:** It uses [concave mirrors](#) to focus incoming light, creating **real, inverted, and smaller images**. Most modern telescopes are reflectors, with **parabolic mirrors** to avoid image blurring.
  - **Refracting Telescope:** A refracting telescope is a telescope that uses **lenses** and refraction to **redirect light** in order to magnify distant objects.
    - The **maximum practicable lens** size in a refracting telescope is around **1 metre**.
    - The world's largest refracting telescope is at [Yerkes Observatory](#) in the US, with a **1.02-m lens**.
- **Measuring Brightness: Apparent magnitude** quantifies the **brightness** of celestial objects in a logarithmic scale.
  - **Lower values** represent **brighter objects** (e.g., Sun at -26.78, Venus at -4.92), while higher values represent dimmer objects (e.g., Andromeda Galaxy at +3.44).
- **Resolution of Telescopes:** The [human eye](#) with 20/20 vision can see details as small as **60 arcseconds** (1 arcsecond = 1/3600th of a degree).
  - A **toy telescope**, with an optimal resolving power of about **1.47 arcseconds**, can see over **40 times more detail** than the human eye.
  - **Resolution** defines the ability of telescopes to distinguish fine details between two close objects.
- **Examples of Largest and Advanced Telescopes:**
  - **Large Binocular Telescope (LBT):** It is the **largest telescope** to date which has two **8.4-m-wide mirrors** and an effective combined aperture of **11.9 m**.
    - It is located at the **Mount Graham International Observatory in Arizona, US**.
  - **Extremely Large Telescope (ELT):** It is under construction atop the **Cerro Armazones mountains** in the Atacama Desert in Chile, as part of the **European Southern Observatory**.
    - It has **five mirrors** and a combined aperture of **39.3 m**.
  - **Subaru Telescope:** It is an **8.2-m-wide** Japanese telescope located at the [Mauna Kea Observatory](#) in Hawaii.
  - [International Liquid Mirror Telescope:](#) It is **India's and Asia's largest telescope**

located at Devasthal in Uttarakhand. It employs a 4-metre-diameter rotating mirror made up of a thin layer of liquid mercury.

## Why are Telescopes Placed on Mountains?

- The Earth's **atmosphere** causes **turbulence**, affecting the clarity of starlight and reducing telescope resolution.
  - **Higher altitudes** like mountains offer **less atmospheric disturbance**.
  - **Space telescopes**, like the **Hubble Space Telescope**, avoid these disturbances entirely, offering 10-times better resolution than ground-based telescopes.
- In recent years, Scientists create **artificial stars with lasers** to analyse atmospheric fluctuations. An advanced method, **tomography**, examines air segments to **eliminate aberrations** for clearer images.

### Q. Consider the following phenomena: (2018)

1. Light is affected by gravity.
2. The Universe is constantly expanding.
3. Matter warps its surrounding space-time.

**Which of the above is/are the prediction/predictions of Albert Einstein's General Theory of Relativity, often discussed in media?**

- (a) 1 and 2 only
- (b) 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

**Ans: (d)**

**Q. In the context of modern scientific research, consider the following statements about 'IceCube', a particle detector located at South Pole, which was recently in the news: (2015)**

1. It is the world's largest neutrino detector, encompassing a cubic kilometre of ice.
2. It is a powerful telescope to search for dark matter.
3. It is buried deep in the ice.

**Which of the statements given above is/are correct?**

- (a) 1 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

**Ans: (d)**

