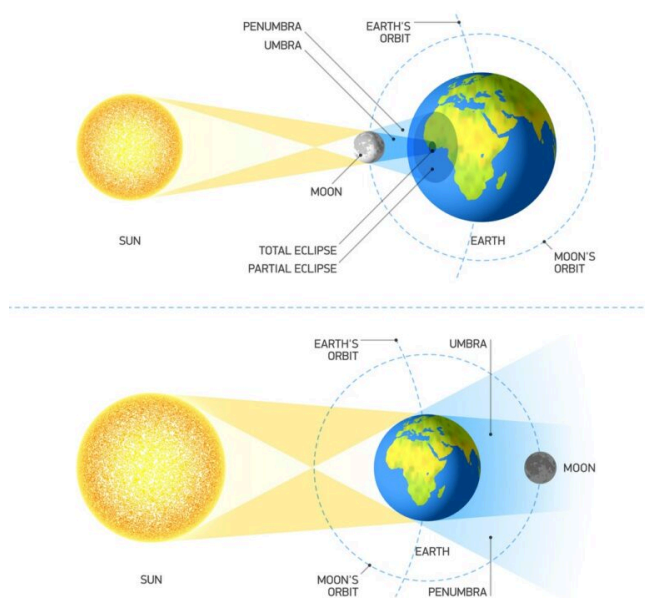


# 10) Eclipses and Phases of the Moon

(ग्रहण और चंद्रमा के चरण)

## 1. Eclipses (ग्रहण)



Eclipses occur due to the alignment of the Sun, Earth, and Moon, causing the shadow of one body to fall on another.

### 1.1 Solar Eclipse (सूर्य ग्रहण)

- Occurs when the Moon is between the Earth and the Sun (New Moon phase).
- The Moon blocks all or part of the Sun's light from reaching the Earth, casting a shadow on Earth.

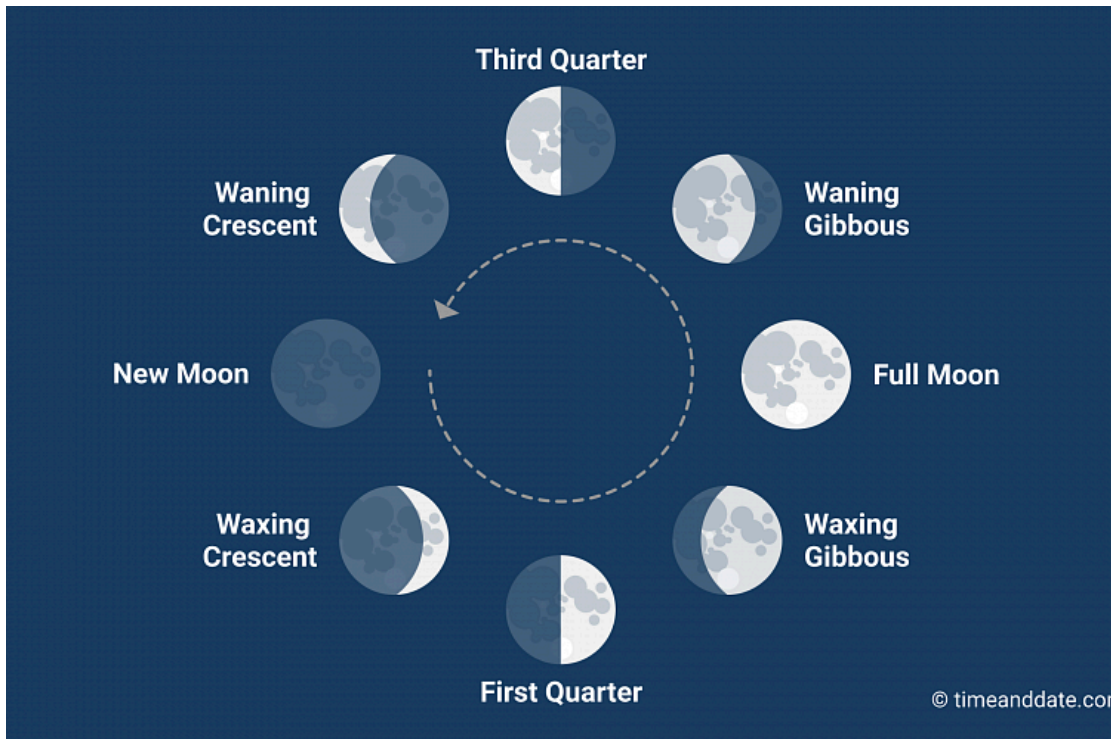
- Types:
  - Total Solar Eclipse: Moon completely covers the Sun.
  - Partial Solar Eclipse: Moon covers only a part of the Sun.
  - Annular Solar Eclipse: Moon is farther away; Sun appears as a bright ring (ring of fire).
- Only visible from limited regions on Earth.

## 1.2 Lunar Eclipse (चंद्र ग्रहण)

- Occurs when the Earth is between the Sun and the Moon (Full Moon phase).
- Earth's shadow falls on the Moon, darkening it.
- Types:
  - Total Lunar Eclipse: Entire Moon falls in Earth's umbra (full shadow).
  - Partial Lunar Eclipse: A portion of the Moon is in umbra.
  - Penumbral Lunar Eclipse: Moon passes through Earth's penumbra (partial shadow) and dims slightly.
- Visible from anywhere on the night side of Earth.

Key Point: Solar eclipses occur only on New Moon while lunar eclipses occur only on Full Moon.

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## 2. Phases of the Moon (चंद्रमा के चरण)

The Moon does not produce its own light but reflects sunlight. The phases change due to the relative positions of the Sun, Earth, and Moon.

### Main Phases (8 phases total):

1. New Moon (अमावस्या): Moon between Earth and Sun; no visible moon from Earth.
2. Waxing Crescent (शुक्ल पक्ष): Small sliver visible after New Moon.
3. First Quarter (पूर्णिमा का पहला चौथाई): Half of the Moon visible (right side in northern hemisphere).

4. Waxing Gibbous (शुक्ल पक्ष का आगे बढ़ना): More than half visible but not full.
5. Full Moon (पूर्णिमा): Entire face visible.
6. Waning Gibbous (कृष्ण पक्ष का घटाव): After Full Moon, illumination decreasing.
7. Last Quarter (पूर्णिमा का दूसरा चौथाई): Half visible (left side in northern hemisphere).
8. Waning Crescent (कृष्ण पक्ष): Thin crescent before New Moon.

Cycle Duration: About 29.5 days (Lunar month).

## Constellations (नक्षत्र/तारामंडल)

Constellations are groupings of stars that form recognizable patterns in the night sky, with 88 officially recognized by the International Astronomical Union (IAU)

### A) Essentials (मूल बातें)

- **Constellation** (तारामंडल): A formally recognised sky pattern/region (IAU-defined); e.g., **Orion, Ursa Major, Scorpius, Virgo**.  
**Asterism** (एस्ट्रिज़्म): Popular pattern **within** or **across** constellations; e.g., **Big Dipper/Saptarishi** (part of Ursa Major), **Summer Triangle**.
- **Zodiac constellations** (राशि मंडल): The **12 constellations** along the **ecliptic belt** (path of Sun, and near which Moon/planets appear):  
**Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpius, Sagittarius, Capricornus, Aquarius, Pisces**.

- **Pole Star (Polaris / ध्रुव तारा):** Near the **North Celestial Pole**, belongs to **Ursa Minor (Little Dipper)**; **Altitude of Polaris  $\approx$  your latitude** (उत्थान  $\approx$  अक्षांश)  $\rightarrow$  useful navigation fact (India  $\approx 8^\circ - 37^\circ\text{N} \Rightarrow$  Polaris is always above the northern horizon).
- **Bright stars often asked (उज्ज्वल तारे):**  
**Sirius** (Canis Major) – brightest star; **Betelgeuse/Rigel** (Orion); **Spica** (Virgo); **Antares** (Scorpius); **Polaris** (Ursa Minor).
- **India-centric visibility (भारत संदर्भ):**  
**Orion** prominent in **winter evenings** (Nov–Feb); **Scorpius** in **summer**; **Ursa Major (Saptarishi)** visible most of the year but changes position and can be low/absent for parts of the night/season depending on latitude.
- **Exam traps (आम भ्रम):**  
Big Dipper **is not** a constellation (it is an **asterism** of Ursa Major).  
Orion **is not** zodiacal (zodiac runs along the ecliptic; Orion lies off the ecliptic).  
Polaris is **not** the brightest star (Sirius is).

## Important One-liners

- Maximum moons: **Saturn**
- Densest planet: Earth; tilted extreme: Uranus ( $\sim 98^\circ$ ).  
सर्वाधिक घनत्व: पृथ्वी; अत्यधिक झुकाव: अरुण ( $\sim 98^\circ$ )।

- Retrograde spin: Venus (slow, opposite), Uranus (sideways).  
प्रतिगामी घूर्णन: शुक्र (धीमा, विपरीत), अरुण (किनारे पर झुका)।
- Venus = hottest surface; Mercury = smallest; Jupiter = largest; Earth = densest.  
शुक्र = सबसे गरम; बुध = सबसे छोटा; बृहस्पति = सबसे बड़ा; पृथ्वी = सबसे घनी।
- Halley's comet ~76 years;.  
हैले धूमकेतु ~76 वर्ष;
- Tropic of Cancer crosses 8 Indian states; IST at 82.5° E.  
कर्क रेखा 8 राज्यों से; IST 82.5° पू. पर आधारित।

**Coriolis Force** is a fictitious force resulting from the rotational movement of the earth. The Coriolis Effect is responsible for many large-scale weather patterns. Coriolis effect is maximum at the poles and zero at the equator.

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