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1. Overview of the Moon

- Type: Natural satellite
- Orbiting Body: Earth
- Distance from Earth: ~384,400 km (238,855 miles)
- Orbital Period: 27.3 days (sidereal month)
- Synodic Period (Full Moon Cycle): 29.5 days
- Rotation Period: 27.3 days (synchronous rotation – same side always faces Earth)
- Diameter: 3,474 km (27% of Earth’s)
- Gravity: 1.62 m/s^2 (16.5% of Earth’s)
- Temperature:
  - Daytime: Up to 127°C (260°F)
  - Nighttime: Down to -173°C (-280°F)
- Moons: None (The Moon itself is Earth’s moon)

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2. Key Characteristics

- Shape: Nearly spherical with a slight bulge at the equator.
- Surface: Covered in dust, rocks, and craters.
- Color: Grey and dusty appearance.
- Atmosphere: Extremely thin exosphere (trace amounts of hydrogen, helium, neon).
- Axial Tilt: 1.5° (minimal seasonal changes).

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3. Phases of the Moon

Phase	Description
New Moon	Moon is between Earth and Sun (not visible).
Waxing Crescent	Small crescent on the right.
First Quarter	Half of the Moon is visible (right side).
Waxing Gibbous	More than half but not full.
Full Moon	Entire face illuminated.
Waning Gibbous	Begins to shrink (left side lit).
Last Quarter	Half visible (left side).
Waning Crescent	Thin crescent before new moon.

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4. Lunar Surface and Features

- Maria (Seas): Dark, flat plains formed by ancient volcanic eruptions (e.g., Mare Tranquillitatis).
- Highlands: Lighter, mountainous, and heavily cratered regions.
- Craters: Formed by meteorite impacts (e.g., Tycho Crater).
- Rilles: Channels or grooves caused by lava flows.
- Mountains: Tall peaks such as Mons Huygens (highest mountain, 5.5 km tall).

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5. Moon’s Orbit and Rotation

- Synchronous Rotation: The Moon rotates on its axis at the same rate it orbits Earth, showing the same face to Earth.
- Libration: Slight wobble allowing us to see about 59% of the Moon’s surface over time.
- Orbit Shape: Elliptical (slightly oval-shaped).
- Closest Point (Perigee): ~363,300 km (226,000 miles)
- Farthest Point (Apogee): ~405,500 km (252,000 miles)

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6. Eclipses

- Solar Eclipse: Moon passes between Earth and the Sun, blocking sunlight.
- Lunar Eclipse: Earth passes between the Sun and the Moon, casting a shadow on the Moon.
- Types of Lunar Eclipses:
    - Total Eclipse: Moon is completely covered by Earth’s shadow.
    - Partial Eclipse: Only part of the Moon enters the shadow.
    - Penumbral Eclipse: Moon passes through Earth’s outer shadow (less noticeable).

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7. Formation of the Moon

- Giant Impact Hypothesis:
    - The Moon likely formed around 4.5 billion years ago when a Mars-sized body (Theia) collided with Earth.
    - Debris from the collision coalesced to form the Moon.

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8. Exploration of the Moon

- First Flyby: Luna 1 (1959, USSR) – First spacecraft to fly past the Moon.
- First Landing: Luna 2 (1959, USSR) – First human-made object to impact the Moon.
- First Human Landing: Apollo 11 (1969, USA) – Neil Armstrong and Buzz Aldrin walked

on the Moon.
- Recent Missions:
  - Chang’e 4 (China, 2019) – First landing on the far side of the Moon.
  - Artemis Program (NASA) – Plans to return humans to the Moon in the 2020s.

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9. Interesting Facts

- Only Natural Satellite: Earth’s only natural satellite.
- Tidal Effects:
  - Causes ocean tides through gravitational pull.
  - Slows Earth’s rotation by about 1.5 milliseconds per century.
- Moonquakes: Quakes occur beneath the surface, likely caused by gravitational interaction with Earth.
- No Atmosphere: No sound or weather occurs on the Moon.
- Moon Dust: Fine, sharp particles cling to equipment and are hazardous to health.

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10. Why is the Moon Important?

- Tides and Stability: Regulates Earth’s tides and stabilizes its axial tilt, influencing climate.
- Space Exploration: A stepping stone for deep space missions.
- Scientific Research: Provides insight into the solar system’s formation and early Earth history.

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11. Key Measurements

Property	Value
Diameter	3,474 km
Distance from Earth	384,400 km
Orbital Period	27.3 days
Rotation Period	27.3 days

Property	Value
Gravity	1.62 m/s²
Surface Temperature	-173°C to 127°C
Atmosphere	Very thin (exosphere)
Moons	None

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12. The Moon in Mythology and Culture

- Named After: “Luna” (Roman goddess of the Moon).
- Symbol:
- Astrological Significance: Represents emotions, intuition, and the subconscious.
- Cultural References: Prominent in mythology, literature, and art across civilizations.

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13. Differences Between the Moon and Earth

Feature	Moon	Earth
Atmosphere	Thin (exosphere)	Thick (78% N_2, 21% O_2)
Surface Temp.	-173°C to 127°C	15°C average
Gravity	1.62 m/s²	9.8 m/s²
Water	Ice at poles	Liquid oceans
Magnetic Field	Weak	Strong

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14. Can the Moon Support Life?

- Surface: Hostile to life – lacks water, atmosphere, and protection from radiation.
- Potential for Colonization:
  - Water ice at the poles may provide resources for future missions.
  - Moon bases could serve as launch points for Mars and beyond.