Guiding Questions

1. Is the Moon completely covered with craters?
2. Has there been any exploration of the Moon since the Apollo program in the 1970s?
3. Does the Moon’s interior have a similar structure to the interior of the Earth?
4. How do Moon rocks compare to rocks found on the Earth?
5. How did the Moon form?
The Moon's Orbit

- The Moon and Earth both orbit around a point between their centers called the **center of mass** of the Earth-Moon system.
- The center of mass then follows an elliptical orbit around the Sun.

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The Moon's airless, dry surface is covered with plains and craters.

- The Earth-facing side of the Moon displays light-colored, heavily cratered highlands and dark-colored, smooth-surfaced maria.
- The Moon's far side has almost no maria.
Virtually all lunar craters were caused by space debris striking the surface.

There is no evidence of plate tectonic activity on the Moon.

The maria formed after the surrounding light-colored terrain, so they have not been exposed to meteoritic bombardment for as long and have fewer craters.
Manned exploration of the lunar surface was one of the greatest adventures in human history.

Much of our knowledge about the Moon has come from human exploration in the 1960s and early 1970s and from more recent observations by unmanned spacecraft.

Near side

Far side

Iron content (percentage by weight)
The Moon has no global magnetic field but has a small core beneath a thick mantle.

Lunar rocks reveal a geologic history quite unlike that of Earth:

- The anorthositic crust exposed in the highlands was formed between 4.0 and 4.3 billion years ago.
- The mare basalts solidified between 3.1 and 3.8 billion years ago.
- The Moon's surface has undergone very little change over the past 3 billion years.

Meteoroid impacts have been the only significant "weathering" agent on the Moon:

- The Moon's regolith, or surface layer of powdered and fractured rock, was formed by meteoritic action.
All of the lunar rock samples are igneous rocks formed largely of minerals found in terrestrial rocks

- The lunar rocks contain no water
- They differ from terrestrial rocks in being relatively enriched in the refractory elements and depleted in the volatile elements

The Moon probably formed from debris cast into space when a huge planetesimal struck the proto-Earth

- The collisional-ejection theory holds that the proto-Earth was struck by a Mars-sized protoplanet and that debris from this collision coalesced to form the Moon
- This theory successfully explains most properties of the Moon
- The Moon was molten in its early stages, and the anorthositic crust solidified from low-density magma that floated to the lunar surface
- The mare basins were created later by the impact of planetesimals and filled with lava from the lunar interior
Tidal interactions between the Earth and Moon are slowing the Earth’s rotation and pushing the Moon away from the Earth.

Objects, each of mass \( m \)

\[ F_{	ext{near}} \]

\[ F_{	ext{far}} \]

Moon, diameter \( d \)

Earth-Moon distance = \( r \)

1. The Moon’s tidal forces elongate Earth’s oceans along an Earth-Moon line.

2. Friction between the spinning Earth and its oceans drags the tidal bulge about \( 10^\circ \) ahead of alignment with the moon.

3. Friction between Earth and its oceans also makes the Earth rotate more slowly, increasing the length of the day.

4. The tidal bulge on the side nearest the Moon exerts a small forward force on the Moon, making it spiral slowly away from Earth.

The Moon—Site of Future Industry?
Key Words

• anorthosite
• capture theory
• center of mass
• co-creation theory
• collisional ejection theory crater
• far side (of the Moon)
• fission theory
• impact breccia
• impact crater
• libration
• lunar highlands
• mare (plural maria)
• mare basalt
• moonquake
• refractory element
• regolith
• synchronous rotation
• terminator
• terrae
• volatile element