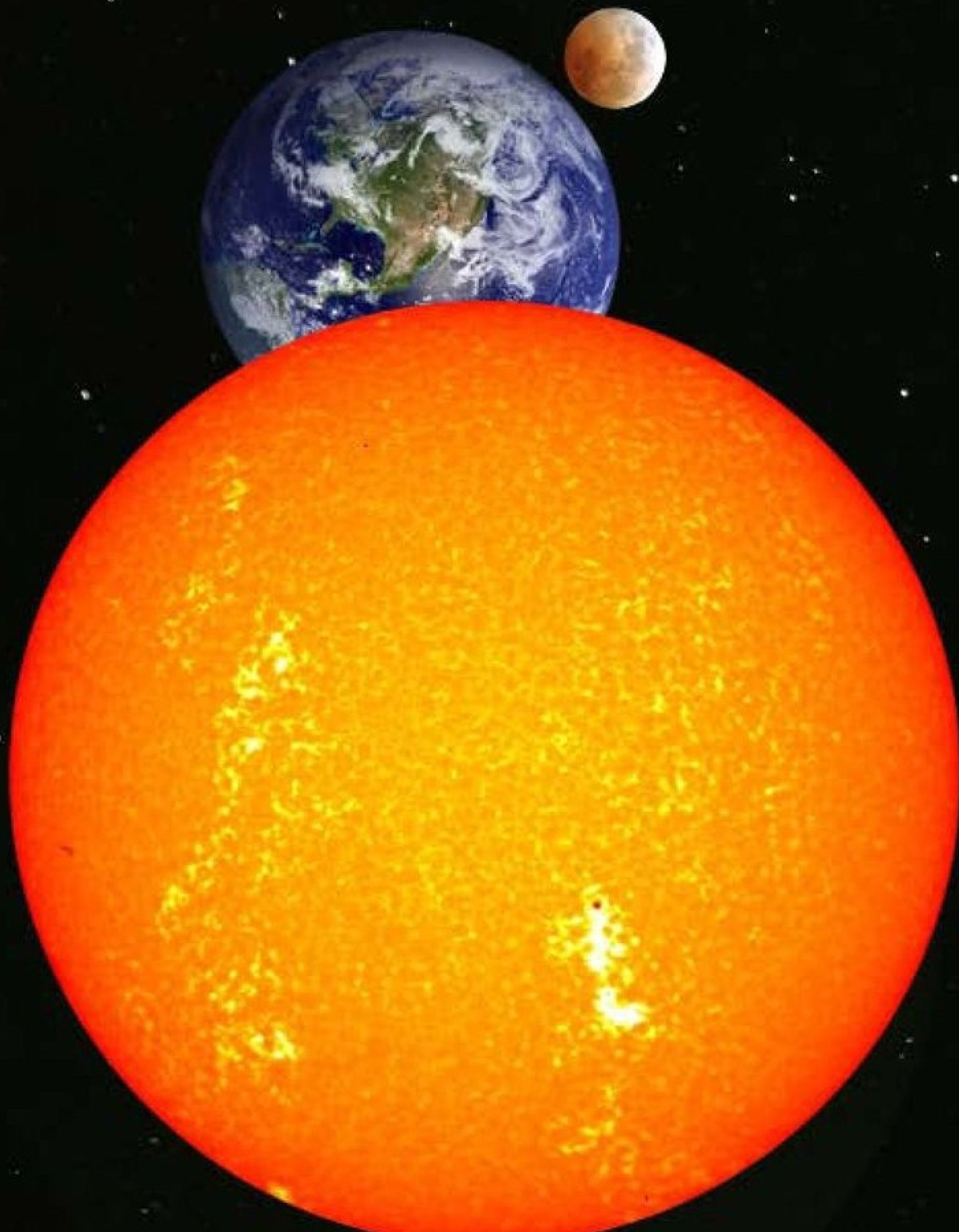
LEVELED BOOK • U

The Sun, Earth, and Moon



Written by David L. Dreier

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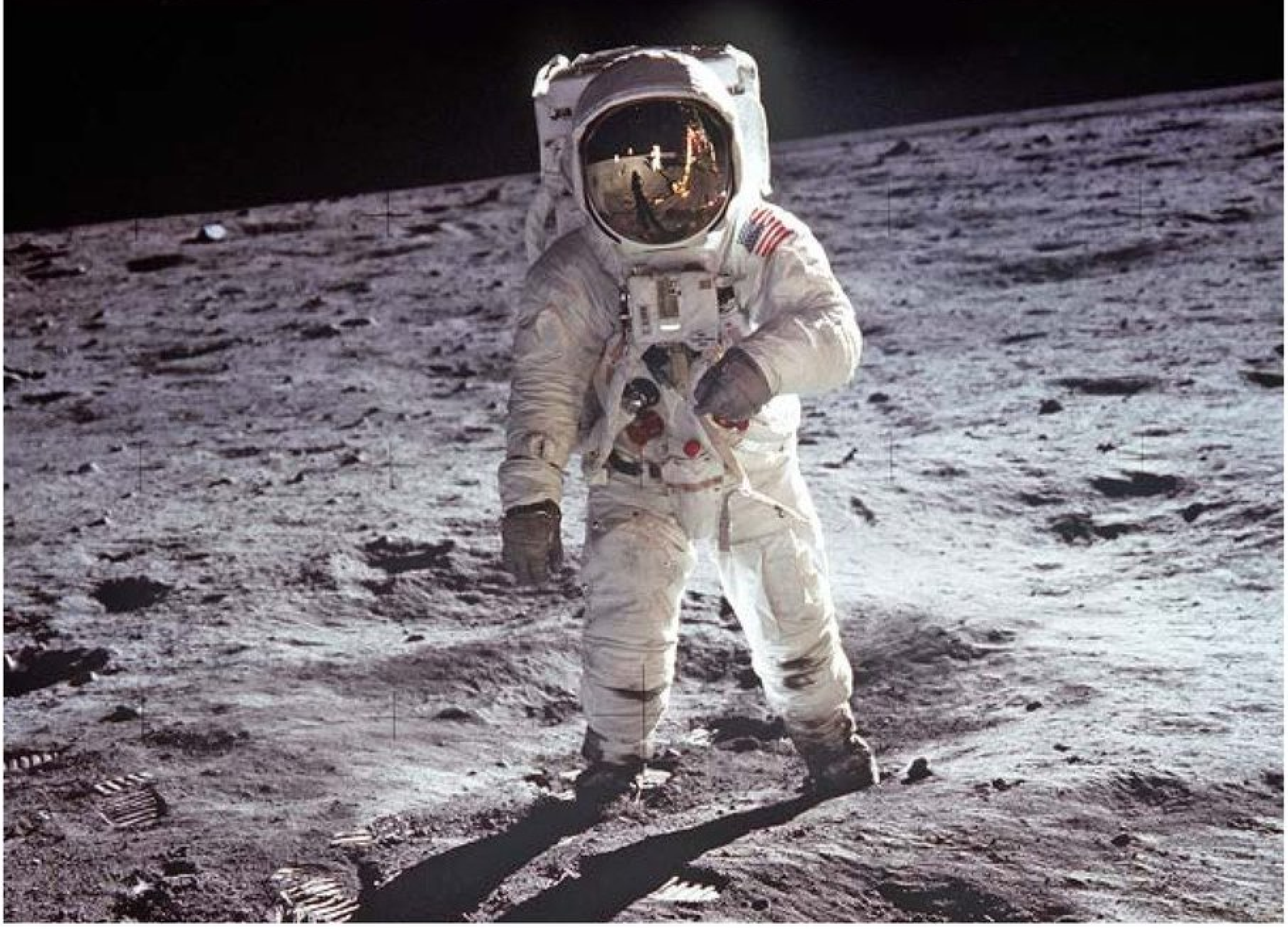

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Focus Question

What is the relationship between the movements of the Earth, Moon, and Sun?

Words to Know

eclipse	rotation
gravity	tides
revolution	

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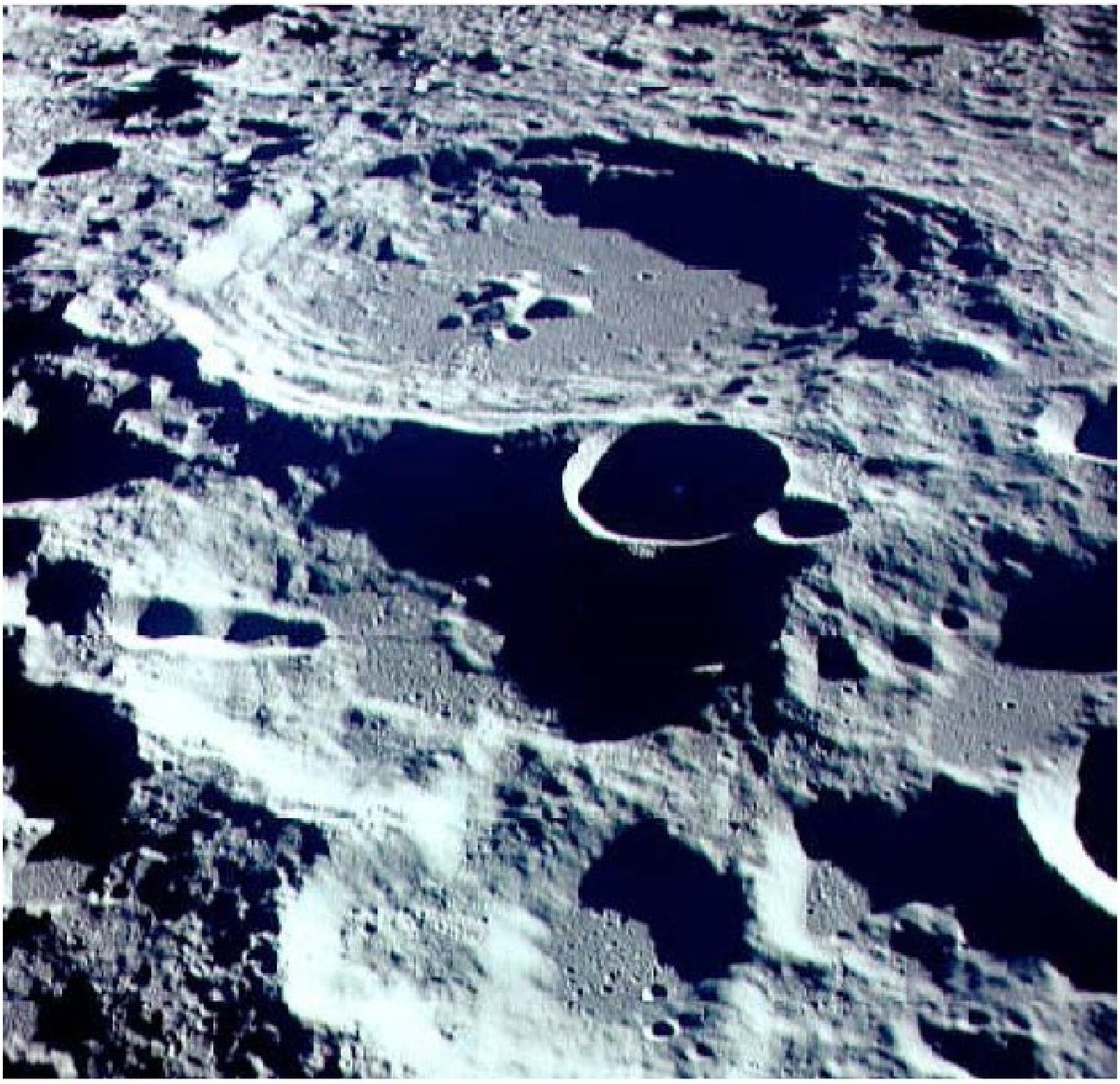
Craters on Earth's Moon

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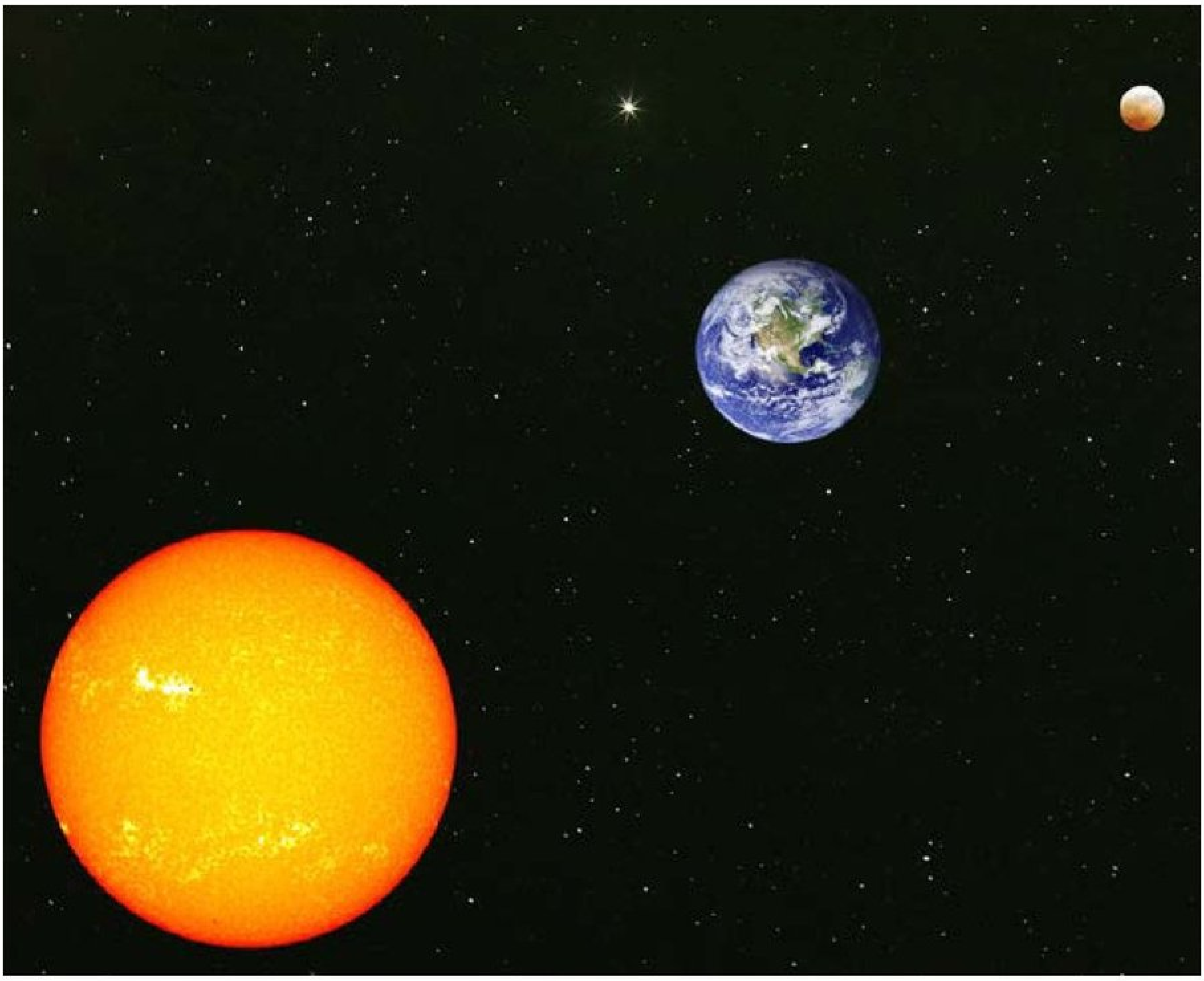

Sun, Earth, and Moon

Three Important Celestial Bodies

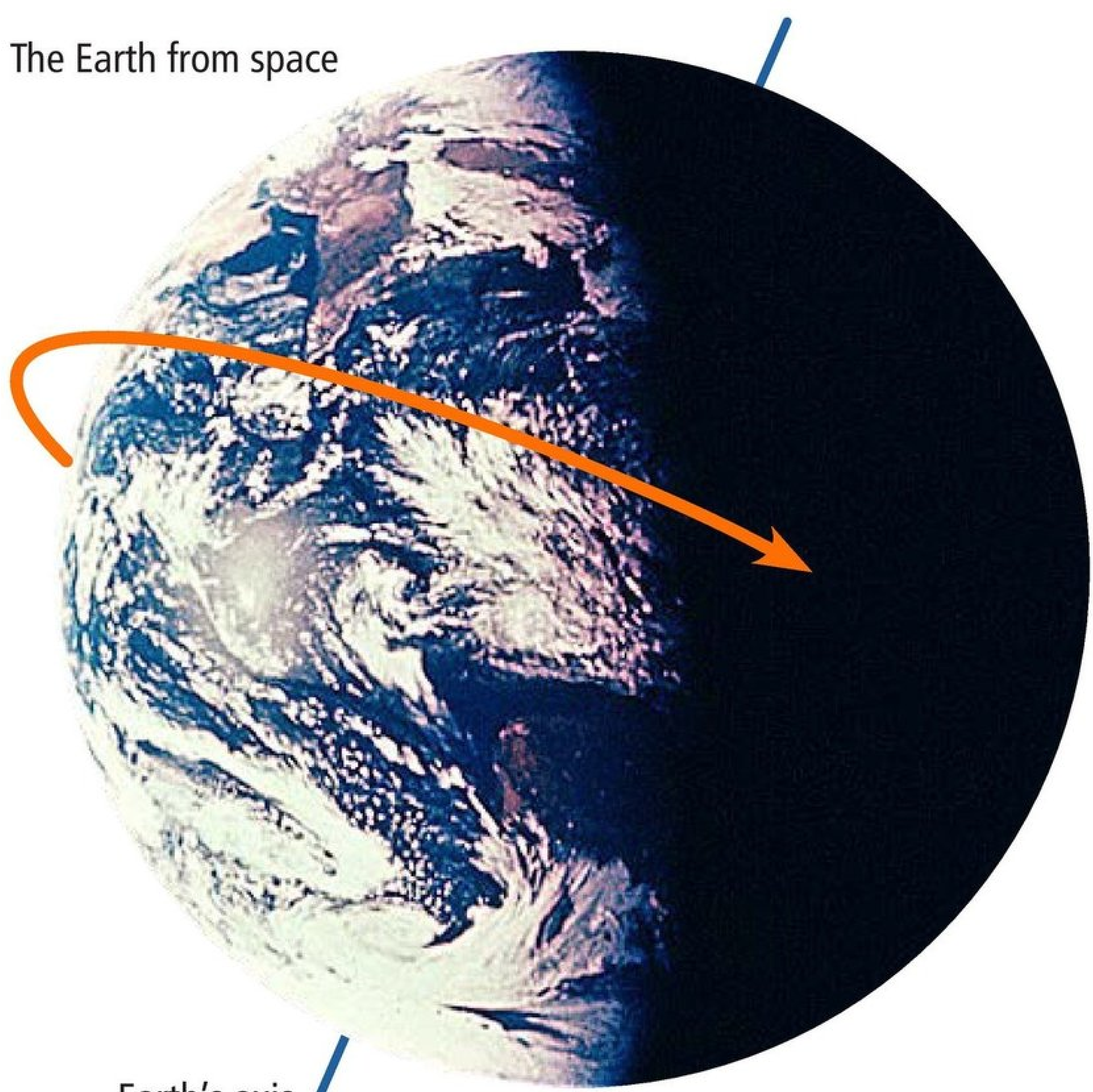
The solar system is our home in the Milky Way Galaxy, a huge spiral of stars, gas, and dust. The solar system consists of the Sun, the planets, their moons, and various kinds of debris. But to us, the three most important objects in the solar system are the Sun, our own planet Earth, and Earth's Moon.

The planets and their moons are always moving—the planets circle the Sun, and the moons circle the planets. It is a ballet of movement that has gone on for billions of years. In this book, we will examine the movements of the Earth and Moon in relation to each other and to the Sun.

The Movements of the Earth

Earth, as all planets and moons in the solar system, undergoes two main movements: **rotation** and **revolution.**

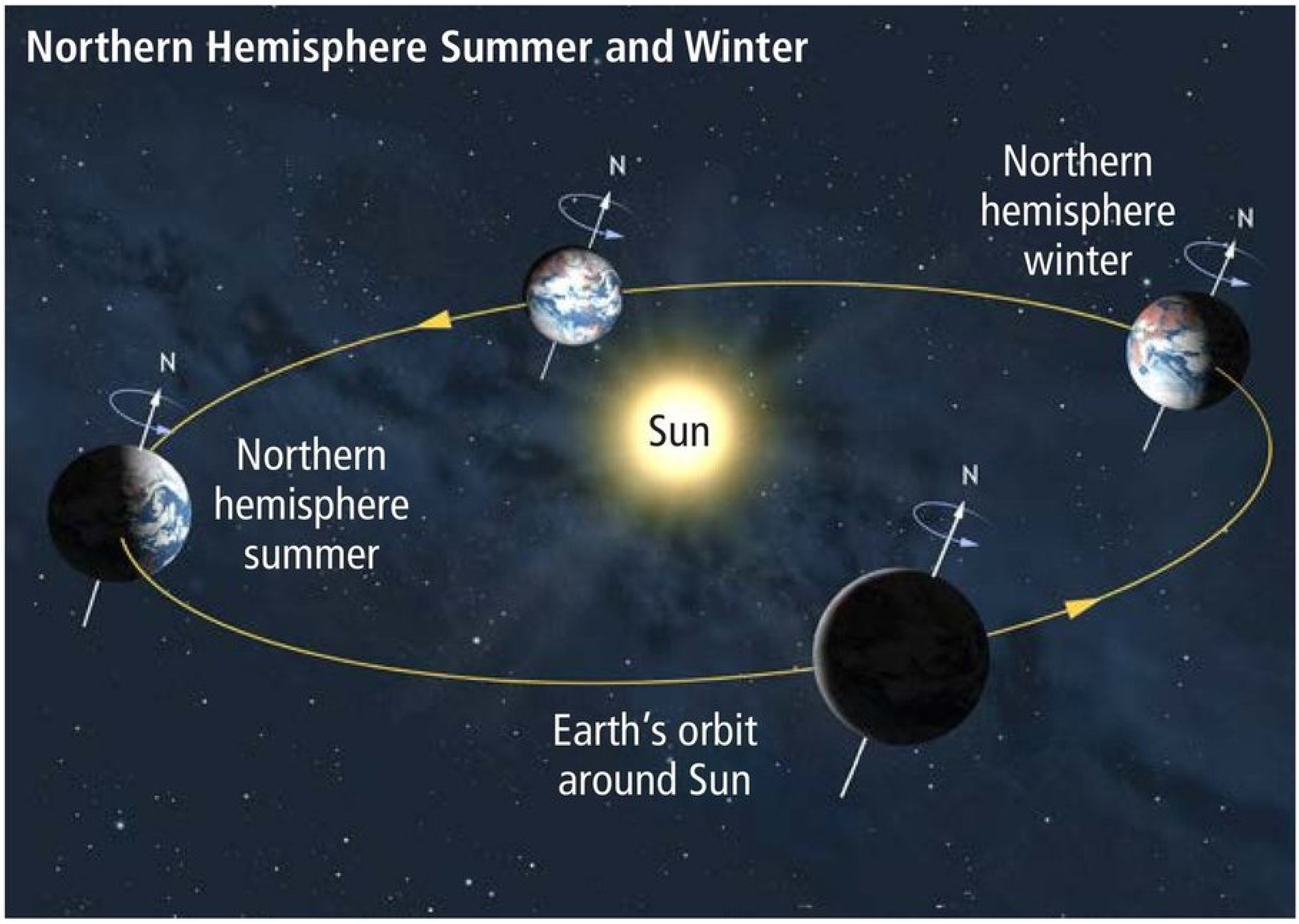
Rotation is the turning of Earth around its axis, an imaginary line that runs vertically through the center of the planet. A single rotation of Earth takes 24 hours. It is Earth's rotation that produces the endless cycle of day and night. When one side of the planet is rotated toward the Sun, it is day on that half of the planet. At the same time, it is night on the other half of the planet.



Earth's revolution is its long orbit around the Sun, which takes about 365 days. One full year thus corresponds to one complete orbit of Earth around the Sun. Actually, a single revolution of our planet around the Sun takes 365¼ days. That is why a leap year must be added to the calendar every four years. A leap year contains one extra day—February 29—which absorbs those four extra quarter days and keeps the calendar in line with the seasons.

Leap years date to the reign of Julius Caesar in ancient Rome. In 1582, Pope Gregory XIII further refined the calendar to make up for a slight error that accumulated over centuries with leap years. We still use Pope Gregory's system, which skips three leap years every four centuries.

Pope Gregory XIII, the man responsible for our current calendar

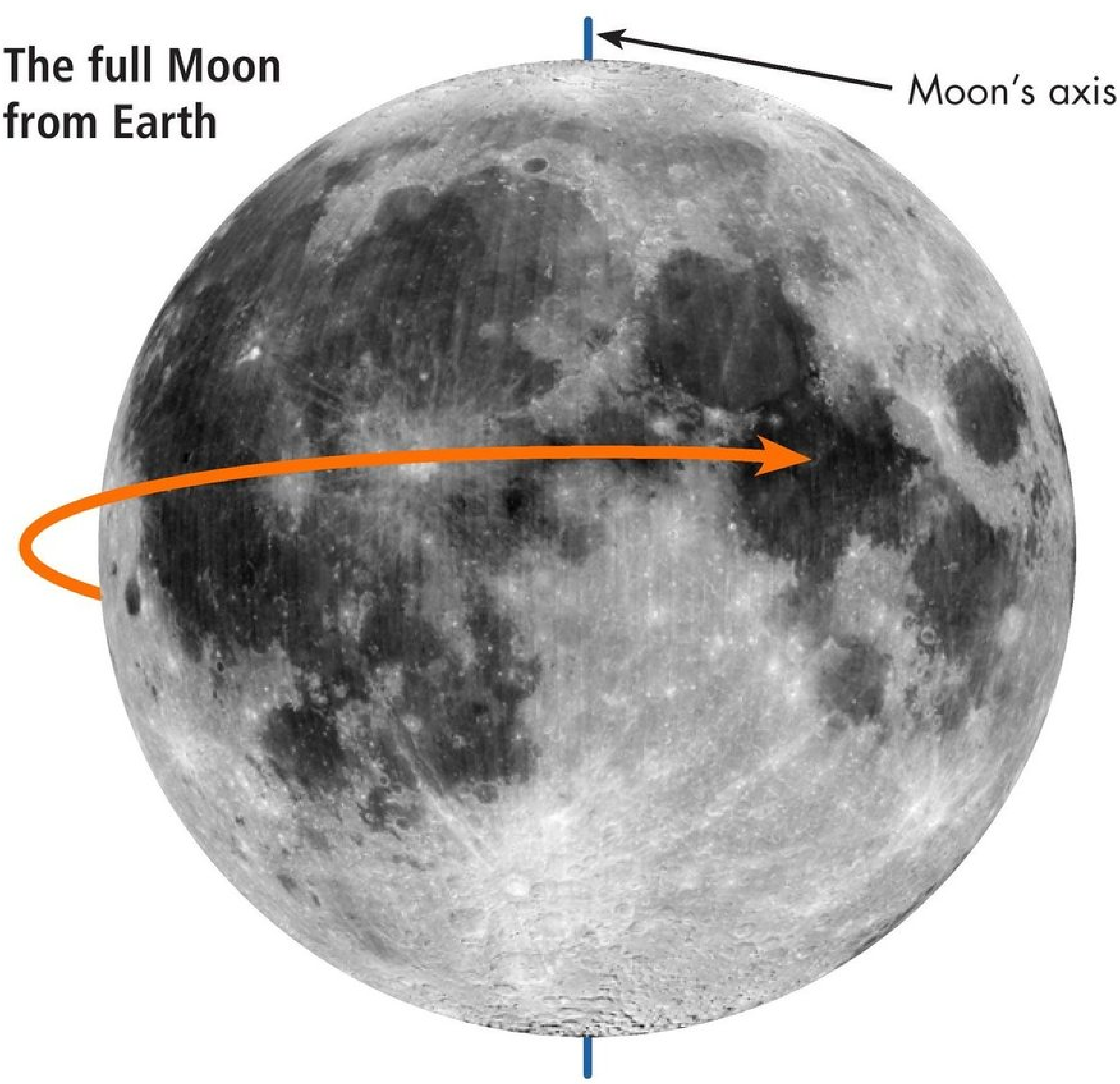


The near-circle out in space that Earth traces in its orbit around the Sun is called its orbital plane. Earth's axis is tilted about 23½ degrees away from its orbital plane. This tilt is what causes the seasons. When the northern hemisphere—the northern half of the planet—is tilted toward the Sun, it is summer in that part of the world. At the same time, it is winter in the southern hemisphere. Half a year later, it is the southern half of the planet that is tilted toward the Sun. Then it is summer there and winter in the northern hemisphere.

The Rotation and Revolution of the Moon

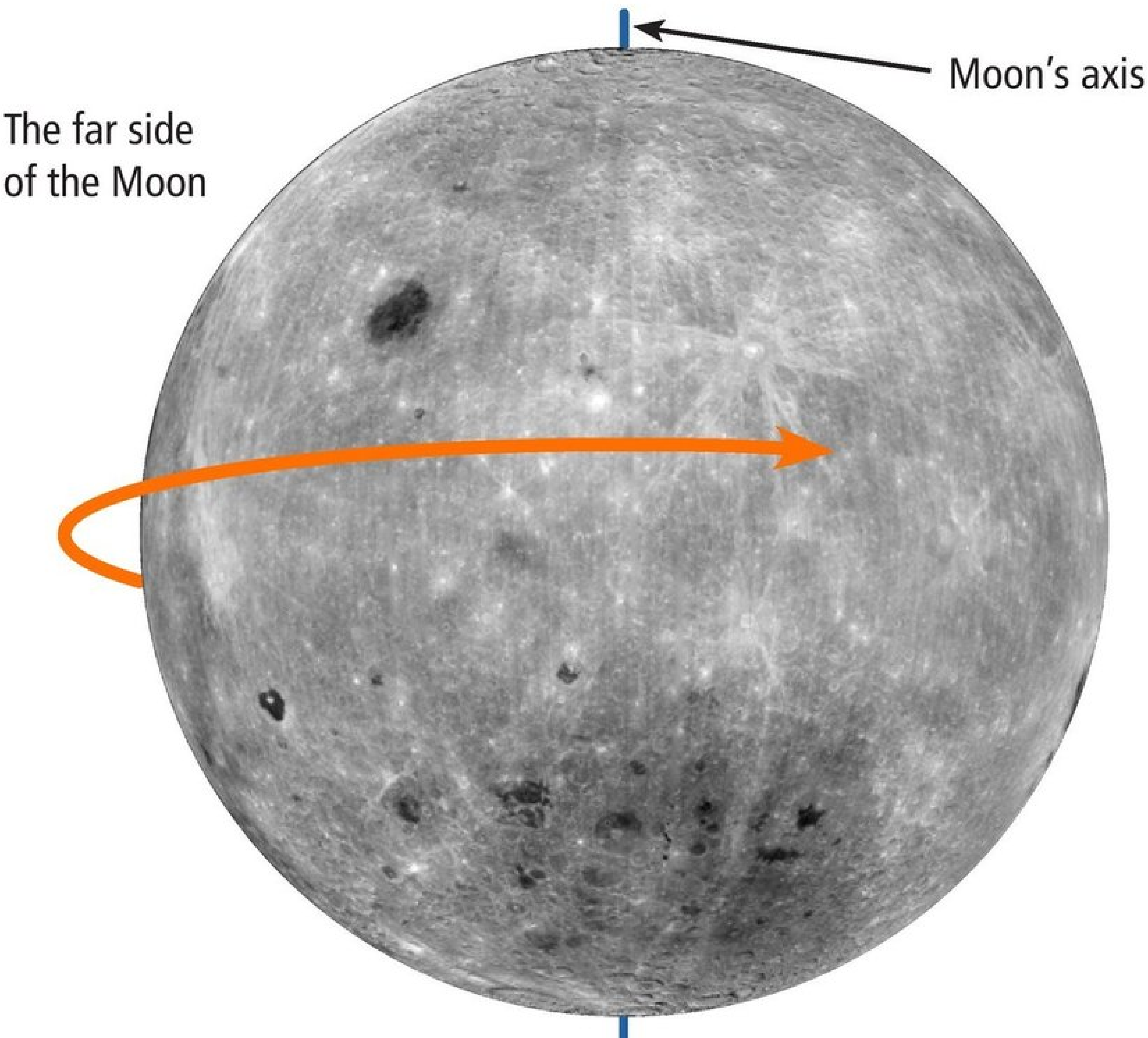
Just as Earth turns on its axis and revolves around the Sun, the Moon turns on its axis and revolves around the Earth. But there is one big difference between the movements of the Earth and Moon. The Earth's periods of rotation and revolution are very different: 24 hours and 365 days. For the Moon, these two movements each take the same amount of time—just over 27½ days. Every 27½ days, the Moon revolves once around Earth and turns once on its axis. Because of that, the Moon always has the same face turned toward Earth.

The full Moon from Earth



There is nothing mysterious about these two movements occurring in the same amount of time. They are a result of the pull of **gravity** between Earth and the Moon. The matching of rotational and orbital periods is called *synchronous rotation*, and it is common in the universe.

Many people think that there is a permanent "dark side" of the Moon, but that is wrong. It is correct to speak of the "far side" of the Moon—the side always turned away from Earth. That side receives just as much sunlight as the side that faces us, just at opposite times. When we see a full moon, the far side is in darkness. But when there is a new moon, and we see the Moon as dark, the far side of the Moon is in full sunlight.

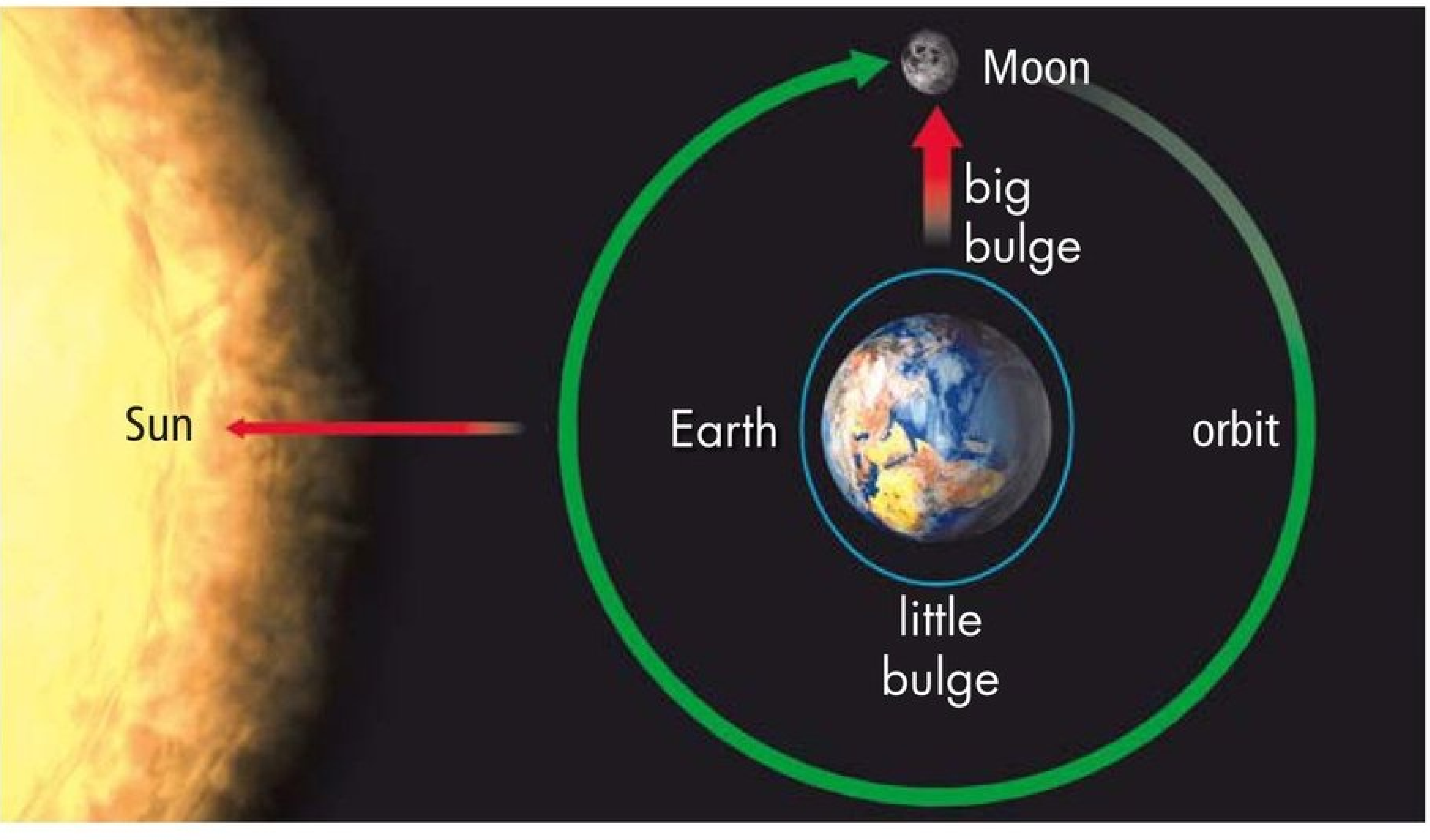


The Tides

Both the Sun and Moon affect Earth with their gravity. It is the Sun's enormous gravity that keeps Earth in orbit around the Sun. Earth's gravity keeps the Moon in an endless orbit around our planet. However, the Moon, though small compared to the Earth and Sun, also exerts a gravitational pull.

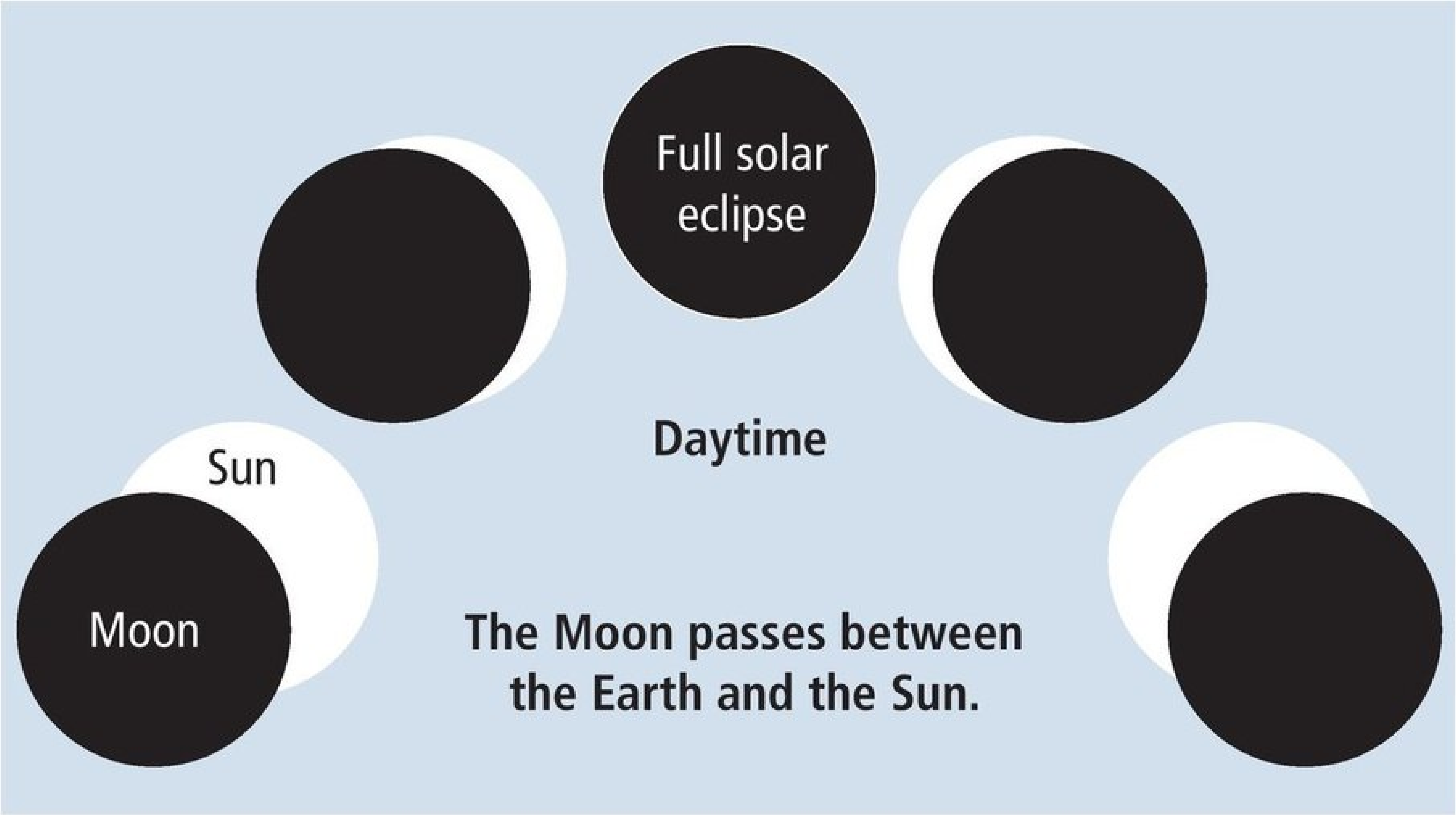
The gravitational pulls of the Sun and Moon produce the **tides** in our planet's oceans. The Moon is much closer to us than the Sun. For that reason, it has a stronger tidal effect than the Sun does.

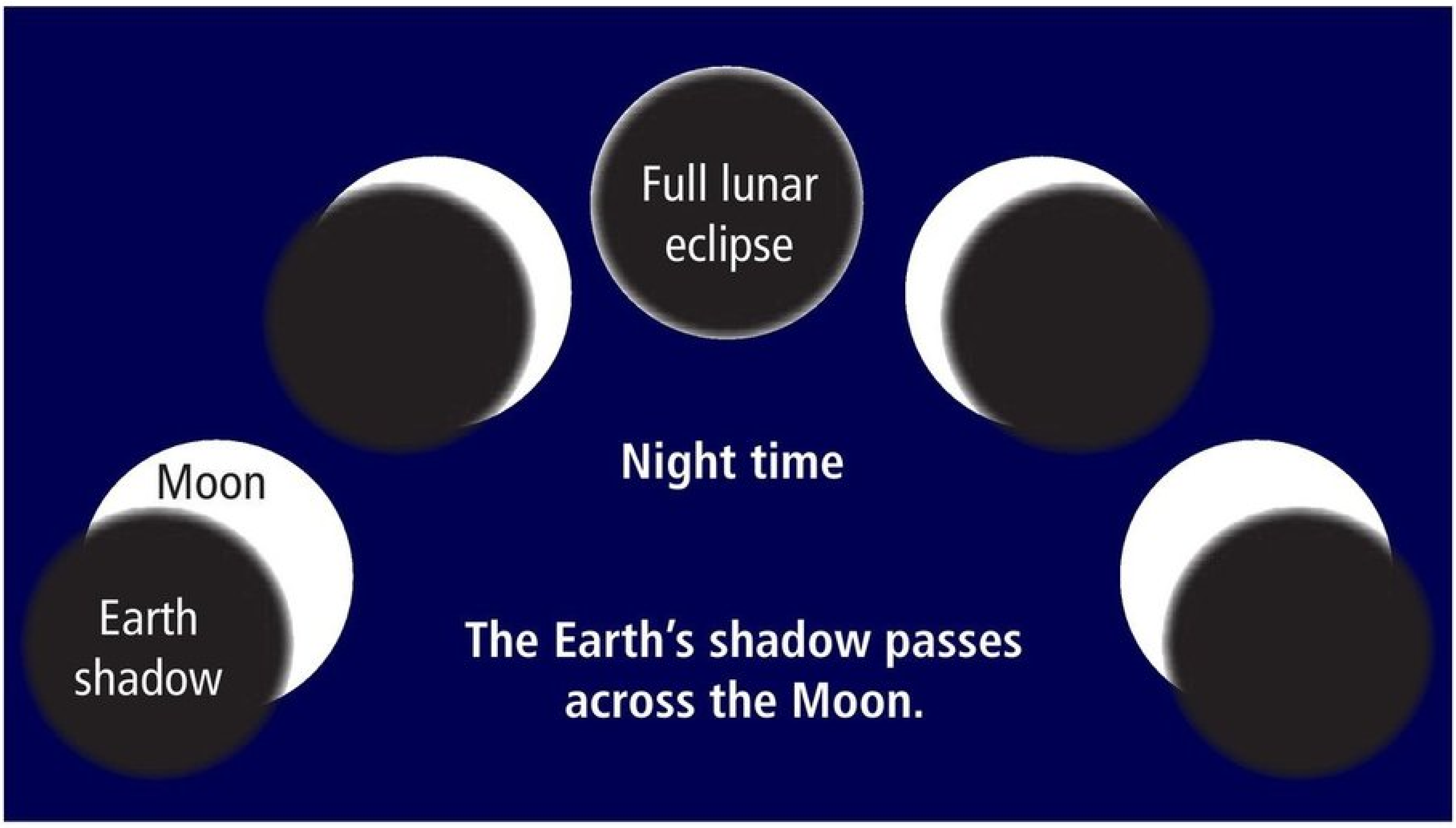
The pull of the Moon's gravity causes the oceans to bulge toward the Moon. Because of the way tidal forces act, the Moon's gravity also causes a bulge to occur on the opposite side of the planet.



The Moon affects the tides on Earth.

As Earth rotates, the high point of a bulge reaches any particular shoreline once every 12 hours. The rising water that this causes is called high tide. When the bulge passes and the water goes out again, it is called low tide. There are two high tides and two low tides in each 24-hour period.





Lunar and Solar Eclipses

As the Earth and Moon move through space, they sometimes get lined up with the Sun. When that happens, the result is a dramatic effect called an **eclipse**. There are two kinds of eclipses, lunar (Moon) eclipses and solar (Sun) eclipses. A lunar eclipse occurs when the Moon is in Earth's shadow from the Sun. A solar eclipse occurs when the Moon passes between Earth and the Sun.

A lunar eclipse is a phenomenon of haunting beauty. As a full moon passes through Earth's shadow, it is illuminated only by rays of sunlight that are scattered through our planet's atmosphere. This light has a reddish cast, so the Moon turns a deep red. A lunar eclipse is visible from the entire side of Earth experiencing night time and can last for more than 1½ hours.

Steps showing how Earth casts a shadow over the Moon during a lunar eclipse

A total solar eclipse

There is no more spectacular sight on Earth than a total eclipse of the Sun. By a coincidence of nature, the Sun and Moon, as seen from Earth, have exactly the same diameter. Because of that, when the Moon passes between Earth and the Sun, it perfectly blocks the Sun's disk. The disk is then blocked for several minutes. During that time, the Sun's corona—its outer glowing gases—becomes clearly visible.

During a solar eclipse, only people in a fairly narrow path on the Earth can see a total eclipse. Most people see a partial eclipse, with part of the Sun's disk still showing. But even with a total eclipse, people are advised to view the phenomenon with special protective glasses.

A full Moon rises over Vancouver, British Columbia, Canada.

Conclusion

The movements of the Earth and Moon seem somehow exactly right. A day is just long enough to accomplish some work, have a relaxing evening, and then get enough sleep to start a new day. The length of one year also seems right. Who would want it to be half its length or twice as long? As for the Moon, its 29½-day cycle of phases is almost equal to a month. We mark our days, months, and years with the movements of our planet and our Moon. And sometimes the Sun and Moon provide us with rare, beautiful displays that we remember for the rest of our lives.

Glossary

eclipse *(n.)*	the partial or complete hiding or darkening of one celestial body, such as the Sun or the Moon, by another (p. 12)
gravity *(n.)*	the natural force that tends to pull objects toward each other, such as objects being pulled toward the center of Earth (p. 9)
revolution *(n.)*	one complete circle made by a planet along its orbital path around another celestial body (p. 6)
rotation *(n.)*	a single turn of something around an axis or a fixed point; spinning (p. 5)
tides *(n.)*	the regular rise and fall of the ocean produced by the gravity of the Moon and Sun (p. 10)

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Connections

Writing

Create a poster that explains how lunar and solar eclipses are alike and different. Present the information to your class.

Science

Why does the Moon appear to change shape throughout the month? Research the phases of the Moon. Create a model or diagram that explains the phases and why they occur.