

# SUPER MOON

## Without Our Lunar Partner There Would Be No Life on Earth

by Hugh Ross

**A**stronomers' quest to find another planet somewhere in the universe capable of supporting life continues in earnest. While this primary goal remains elusive, the search has succeeded in revealing new insights about the features essential for a planet to host life. As research advances, planet Earth appears all the more rare and exquisitely designed as a viable habitat for advanced life.

This is the face of the Moon that we see from Earth. This image is based on data from NASA's Lunar Reconnaissance Orbiter spacecraft.

Perhaps you've already learned that a life-sustaining planet must reside in a particular orbit around its star—an orbit where heat is sufficient, but not too intense, where radiation is present but not too deadly, where water is sufficient but not overabundant, etc. To date, 13 such planetary habitable zones have been identified as essential for life's existence, and the number seems likely to continue growing.<sup>1</sup>

Meanwhile, astronomers have been able to find and to determine at least some of the orbital and other physical features of nearly 5,400 planets.<sup>2</sup> Many of these planets reside in one, and several reside in two, of the specific zones essential for habitability, such as the zones where liquid water may be available and where the incident ultraviolet radiation is suitable for life. However, only one planet—among all those yet discovered—is known to reside where *all* 13+ planetary habitability zones simultaneously converge, and that's our Earth. Astronomers have also come to recognize that significant credit for our planet's extraordinary suitability for advanced life goes to our extra-large Moon and its stabilizing influence.

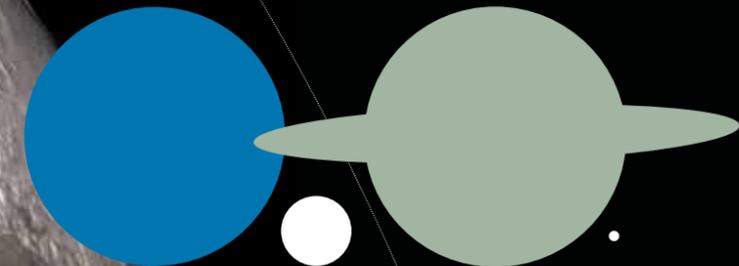
### Earth's Moon as a Contributor to Life

Since the 1990s, astronomers have understood that life more advanced than microbes requires a rocky planet orbited by a moon of substantial mass. Only our relatively massive moon could sufficiently stabilize Earth's rotation axis to provide us with a survivable climate stability. In the case of the Earth-Moon system, the lunar mass equals 1.230 percent of Earth's mass.<sup>3</sup> This percentage may seem small at first glance, but relative to its host planet, it is unprecedented. The second highest known moon-to-planet mass ratio is that of Titan, which orbits Saturn. Titan's mass equals 0.0236 percent of Saturn's mass. The Moon-to-Earth mass ratio is 52 times greater.

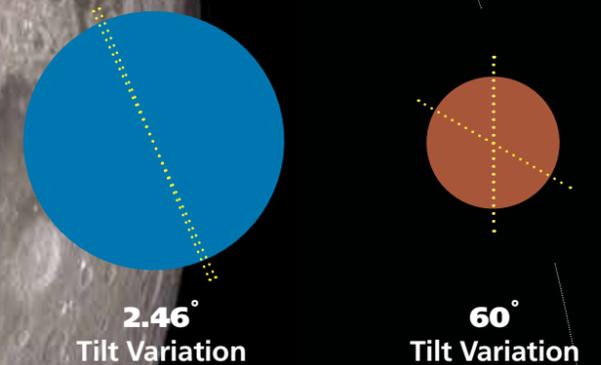
The relative massiveness of our Moon maintains Earth's slight rotation axis tilt variation of 22.04 to 24.50 degrees. By comparison, Mars's

### Earth vs. Saturn Moon Mass Ratios

\*Saturn is 10x diameter of Earth.



### Earth vs. Mars Axis Tilt Variation



rotation axis tilt varies from 0–60 degrees. The steady tilt of Earth's rotation axis means our climate remains sufficiently stable to allow for the existence of advanced life.

Thanks to the combination of our Moon's high mass relative to Earth's *and* its proximity to Earth (see figure), lunar tidal forces effectively recycle life-critical nutrients all along Earth's continental shelves, thereby sustaining the biomass and biodiversity that advanced life requires.

The Moon's tidal forces for the past 4.47 billion years<sup>4</sup> have served to gradually slow Earth's

### Earth-Moon System

\*Earth-Moon sizes and separation distances are to scale.



rotation rate from 3–4 hours per day to the current rate of 24 hours per day. A 24-hour rotation rate happens to be ideal for advanced life, whereas a 23- or 25-hour rotation rate would result in either inhospitable climate or temperature effects that would limit where humans could live on Earth.<sup>5</sup> Thanks to the Moon's just-right mass and orbital recession rate (i.e., gradual distancing from Earth), Earth arrived at a 24-hour rotation rate just as the Sun's luminosity became adequately stable for existence of advanced life.<sup>6</sup>

The Moon also rescued Earth from losing all of its atmosphere and surface water. During the first 700 million years of the Sun's existence, it blasted out particles and radiation that would have sputtered away all of Earth's atmosphere and water if not for the Moon's characteristics. Both the early Earth and early Moon possessed hot liquid iron cores. Because the two bodies were sufficiently close to one another, their mutual tidal forces caused the liquid iron in their cores to circulate. This circulation generated powerful magnetic fields around the two bodies. Nothing less than the coupling of these two fields, called magnetospheres, could have preserved Earth's atmosphere and surface oceans.<sup>7</sup>

### Typical Moons as a Danger to Life

In a recently published paper, physicist Bradley Hansen has demonstrated that large moons orbiting rocky planets would be more likely to *destabilize*, rather than to stabilize, their planetary hosts and entire planetary systems.<sup>8</sup>

Hansen cites research showing that it takes a fine-tuned collision between two (or more) rocky planets to form a large moon, one that subsequently remains for extended time in orbit about its planet.<sup>9</sup> A collision and consequent merger of two rocky planets cause the resulting rocky planet to rotate more rapidly than it did prior to the collision and merger. If the consequent planet's rotation rate is too low, the planet will extract angular momentum from the orbit of the newly formed body, the moon, causing it to spiral inward and, relatively quickly, crash back into the planet. On

the other hand, if the planet's subsequent rotation rate is sufficiently high, the angular momentum will be transferred to its moon, causing it (in nearly all cases) to spiral outward until it escapes the gravitational grip of the planet.

Hansen further demonstrated that once the large moon escapes its planet's gravitational hold, another collision with its planet will eventually occur. Here's why: when the moon spirals outward to the point at which it no longer orbits its planet, it still continues to share the planet's orbit about their host star. Thus, the runaway moon will experience repeated close encounters with its planet over time. Thus, Hansen showed that "nearly all of the freed exomoons will eventually collide with the original host planet."<sup>10</sup>

Hansen's study tells us that one day, but not anytime soon, the Moon will collide with Earth. Today, the Moon is spiraling away from Earth at a rate of 3.82 centimeters per year. Because of how massive the Moon is relative to Earth, the tidal forces exerted by the Moon on Earth will someday slow the planet's rotation rate to a point at which Earth will become tidally locked to the Moon.

That is, one hemisphere of Earth will always face the Moon. This event will cause the movement of the Moon away from Earth to reverse. Forty billion years from now, the Moon will collide with Earth. Before then, however, in just 4.5 billion years, the Sun will become a red giant star and incinerate both the Moon and Earth. For those who think our planet will be stable and habitable forever, this news is sobering, if not devastating. On the other hand, the relationship and features of both the Moon and Earth appear to have been carefully and strategically orchestrated.

### Tabby's Star as an Illustration

In 2015, the star KIC 8462852 was investigated by a team of astronomers led by Tabetha Boyajian and quickly became a media sensation.<sup>11</sup> Unusual luminosity fluctuations in a star that came to be known as "Tabby's star"—fluctuations such as a dimming of its light output by as much as 22 percent—caused astronomers and other sky watchers to speculate that an extraterrestrial intelligent

civilization might have constructed a "Dyson sphere" around the star.

A Dyson sphere is a megastructure hypothesized by physicist Freeman Dyson. In Dyson's scenario, an intelligent species that captures a large percentage of its host star's power output could potentially transform that power into useful energy for its civilization. An opaque alien megastructure surrounding a star would certainly be responsible for blocking or dimming its light to such a degree as that which researchers noted in the case of Tabby's star.

However, Hansen's study, to the disappointment of many, provides a reasonable explanation for the KIC 8462852 luminosity variations. The collision of one or more moons with one or more planets in the star's orbit would have generated huge clouds of dust around the star and, thus, would account for the observed dimming variations.

Follow-up observations of KIC 8462852 that continued through 2017 did, in fact, show wavelength-dependent dimming consistent with huge dust clouds periodically blocking out some of KIC 8462852's light, just as Hansen's model predicts. An opaque alien megastructure would have blocked out all wavelengths equally.<sup>12</sup> (The plausibility of such a structure's existence represents an entirely separate matter for discussion.)

### Additional Surprises

Hansen further explained that these inevitable collisions between rocky planets and their large moons would likely eradicate life or the possibility of life on all neighboring bodies within a given planetary system. Advanced-life-habitable planets

## The relationship and features of both the Moon and Earth appear to have been carefully and strategically orchestrated.

must not only be rocky and reside in all 13 known habitable zones simultaneously, but they must also possess a moon that's neither much more nor much less than 1 percent of the planet's mass. Such a moon has the right mass to remain in a stable orbit about the planet for a sufficient length of time—sufficient time for advanced life to exist and endure and discover these facts.

The idea that all these requirements could be met without invoking supernatural, super-intelligent Agency seems beyond any realistic probability.<sup>13</sup> Hansen's research seems to add even more weight to the ever-growing body of evidence for the existence and action of a personal, purposeful Creator. We humans and our home would appear to be part of a divine plan that extends beyond the known boundaries of matter, energy, space, and time. We simply cannot, at least not reasonably, take our existence for granted. •

#### Notes

1. Hugh Ross, *Improbable Planet* (Grand Rapids, MI: Baker, 2016), 81–93; Hugh Ross, *Designed to the Core* (Covina, CA: RTB Press, 2022), 132–181.
2. Exoplanet TEAM, "Catalog," *The Extrasolar Planets Encyclopaedia*, accessed May 22, 2023, <http://exoplanet.eu/catalog/>.
3. Mark A. Wieczorek et al., "The Constitution and Structure of the Lunar Interior," *Reviews in Mineralogy and Geochemistry* 60, no. 1 (January 1, 2006): 221–364, doi:10.2138/rmg.2006.60.3.
4. Robin M. Canup et al., "Origin of the Moon," (March 2, 2021): 13–14, arXiv:2103.02045. This paper is a chapter in *New Views of Moon II*, a volume of *Reviews in Mineralogy and Geochemistry*.
5. Ross, *Designed to the Core*, 173; Dave Waltham, "Anthropic Selection for the Moon's Mass," *Astrobiology* 4, no. 4 (December 20, 2004): 460–461, doi:10.1089/ast.2004.4.460.
6. Ross, *Designed to the Core*, 117–129.
7. Hugh Ross, "Earth-Moon Coupled Magnetosphere Paved the Way for Life," *Today's New Reason to Believe* (blog), Reasons to Believe, September 20, 2021, <https://reasons.org/explore/blogs/todays-new-reason-to-believe/>

8. Bradley M. S. Hansen, "Consequences of Dynamically Unstable Moons in Extrasolar Systems," *Monthly Notices of the Royal Astronomical Society* 520, no. 1 (March 2023): 761–772, doi:10.1093/mnras/stac2847.
9. Robin M. Canup, "Lunar-Forming Impacts: Processes and Alternatives," *Philosophical Transactions of the Royal Society A* 372, no. 2024 (September 13, 2014): id. 20130175, doi:10.1098/rsta.2013.0175; Canup et al., "Origin of the Moon."
10. Hansen, "Consequences of Dynamically Unstable Moons," 762.
11. Tabetha S. Boyajian et al., "Planet Hunters IX. KIC 8462852—Where's the Flux?" *Monthly Notices of the Royal Astronomical Society* 457, no. 4 (April 2016): 3988–4004, doi:10.1093/mnras/stw218.
12. Tabetha S. Boyajian et al., "The First Post-Kepler Brightness Dips of KIC 8462852," *Astrophysical Journal Letters* 853, no. 1 (January 20, 2018): id. L8, doi:10.3847/2041-8213/aaa405.
13. Independent of Hansen's study, this remote possibility is documented in other books, including *Improbable Planet* and *Designed to the Core*.