

Temperate earth-sized worlds found in extraordinarily rich planetary system (Update)

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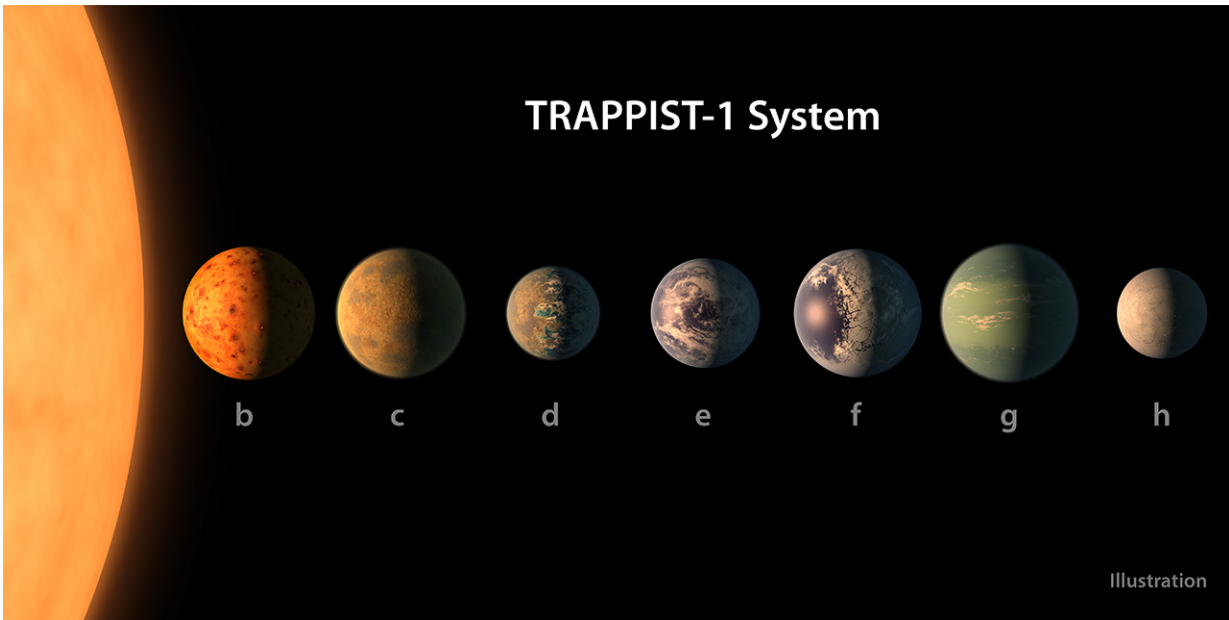
This artist's impression shows the view from the surface of one of the planets in the TRAPPIST-1 system. At least seven planets orbit this ultra cool dwarf star 40 light-years from Earth and they are all roughly the same size as the Earth. They are at the right distances from their star for liquid water to exist on the surfaces of several of them. Credit: ESO/M. Kornmesser

Astronomers have found a system of seven Earth-sized planets just 40 light-years away. They were detected as they passed in front of their parent star, the dwarf star TRAPPIST-1. Three of them lie in the habitable zone and could harbour water, increasing the possibility that the system could play host to life. It has both the largest number of Earth-sized planets yet found and the largest number of worlds that could support liquid water.

Astronomers using the TRAPPIST-South telescope at ESO's La Silla Observatory, the Very Large Telescope (VLT) at Paranal and the NASA Spitzer Space Telescope, as well as other telescopes around the world, have now confirmed the existence of at least seven small [planets](#) orbiting the cool [red dwarf star](#) TRAPPIST-1. All the planets, labelled TRAPPIST-1b, c, d, e, f, g and h in order of increasing distance from their [parent star](#), have sizes similar to Earth.

Dips in the star's light output caused by each of the seven planets passing in front of it (astronomy)—events known as transits—allowed the astronomers to infer information about their sizes, compositions and orbits. They found that at least the inner six planets are comparable in both size and temperature to the Earth.

Lead author Michaël Gillon of the STAR Institute at the University of Liège in Belgium is delighted by the findings: "This is an amazing planetary [system](#)—not only because we have found so many planets, but because they are all surprisingly similar in size to the Earth!"



This artist's concept shows what the TRAPPIST-1 planetary system may look like, based on available data about the planets' diameters, masses and distances from the host star. Credit: NASA-JPL/Caltech

With just 8% the mass of the Sun, TRAPPIST-1 is very small in stellar terms—only marginally bigger than the planet Jupiter—and though nearby in the constellation Aquarius (constellation)) (The Water Carrier), it appears very dim. Astronomers expected that such dwarf stars might host many Earth-sized planets in tight orbits, making them promising targets in the hunt for extraterrestrial life, but TRAPPIST-1 is the first such system to be found.

Co-author Amaury Triaud expands: "The energy output from dwarf stars like TRAPPIST-1 is much weaker than that of our Sun. Planets would need to be in far closer orbits than we see in the Solar System if there is to be surface water. Fortunately, it seems that this kind of compact configuration is just what we see around TRAPPIST-1!"

The team determined that all the planets in the system are similar in size to Earth and Venus in the Solar System, or slightly smaller. The density measurements suggest that at least the innermost six are probably rocky in composition.



Imagine standing on the surface of the exoplanet TRAPPIST-1f. This artist's concept is one interpretation of what it could look like. Credit: NASA/JPL-Caltech

The planetary orbits are not much larger than that of Jupiter's Galilean moon system, and much smaller than the orbit of Mercury in the Solar System. However, TRAPPIST-1's small size and low temperature mean that the energy input to its planets is similar to that received by the [inner planets](#) in our Solar System; TRAPPIST-1c, d and f receive similar amounts of energy to Venus, Earth and Mars, respectively.

All seven planets discovered in the system could potentially have [liquid water](#) on their surfaces, though their orbital distances make some of them more likely candidates than others. Climate models suggest the innermost planets, TRAPPIST-1b, c and d, are probably too hot to support liquid water, except maybe on a small fraction of their surfaces. The orbital distance of the system's outermost planet, TRAPPIST-1h, is unconfirmed, though it is likely to be too distant and cold to harbour liquid water—assuming no alternative heating processes are occurring. TRAPPIST-1e, f, and g, however, represent the holy grail for planet-hunting astronomers, as they orbit in the star's [habitable zone](#).

These new discoveries make the TRAPPIST-1 system a very important target for future study. The NASA/ESA Hubble Space Telescope is already being used to search for atmospheres around the planets and team member Emmanuël Jehin is excited about the future possibilities: "With the upcoming generation of telescopes, such as ESO's European Extremely Large Telescope and the NASA/ESA/CSA James Webb Space Telescope , we will soon be able to search for water and perhaps even evidence of life on these worlds."

This research was presented in a paper entitled "Seven temperate terrestrial planets around the nearby ultracool [dwarf star](#) TRAPPIST-1", by M. Gillon et al., to appear in the journal *Nature*.

More information: Seven temperate terrestrial planets around the nearby ultracool dwarf star TRAPPIST-1, *Nature*, [nature.com/articles/doi:10.1038/nature21360](https://www.nature.com/articles/doi:10.1038/nature21360)

More on TRAPPIST-1: exoplanets.nasa.gov/trappist1/

Provided by ESO

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