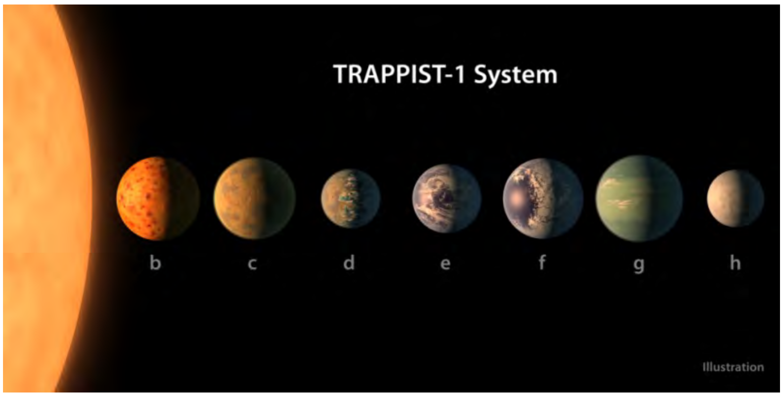
Wow! Nearby TRAPPIST-1 has 7 planets



Scientists using the Spitzer Space Telescope and ground-based telescopes have discovered that there are seven Earth-size planets in the system.

At a news conference in Washington D.C. on February 22, 2017, NASA announced that its Spitzer Space Telescope has observed the first known system of seven Earth-size planets around a single star. Three of these planets are firmly located in what's called the habitable zone, the area around the parent star where a rocky planet is most likely to have liquid water – key to life as we know it. The discovery sets a new record for greatest number of known planets in a star's habitable zone. After all, our solar system has only two planets in the habitable zone: Earth and Mars. This exoplanet system – called TRAPPIST-1 – has three. Because they are located outside of our solar system, these planets are scientifically known as exoplanets.

This illustration shows the possible surface of TRAPPIST-1f, one of the newly discovered planets in the TRAPPIST-1 system

Only about 40 light-years (235 trillion miles) from Earth, in the direction to our constellation Aquarius, TRAPPIST-1 is classified as an ultra-cool dwarf. It's so cool that liquid water could survive on planets orbiting very close to it, closer than is possible on planets in our solar system. All seven of the TRAPPIST-1 planetary orbits are closer to their host star than Mercury is to our sun. According to a NASA statement:

The planets also are very close to each other. If a person was standing on one of the planet's surface, they could gaze up and potentially see geological features or clouds of neighboring worlds, which would sometimes appear larger than the moon in Earth's sky.

The researchers say that the planets might also be tidally locked to the TRAPPIST-1 star. That means that the same side of the planet is always facing the star, therefore each side is either in perpetual day or night. If that's true, the planets could have weather patterns totally unlike those on Earth, such as strong winds blowing from the day side to the night side, and extreme temperature changes.

According to a study published today in the journal Nature all of the TRAPPIST-1 planets are likely to be rocky. Further observations will hopefully reveal whether any have liquid water on their surfaces. The mass of the seventh and farthest exoplanet hasn't yet been estimated. Scientists believe it could be an icy, "snowball-like" world.

Michael Gillon, lead author of the paper and the principal investigator of the TRAPPIST exoplanet survey at the University of Liege, Belgium. Gillon said in a statement:

> *The seven wonders of TRAPPIST-1 are the first Earth-size planets that have been found orbiting this kind of star. It is also the best target yet for studying the atmospheres of potentially habitable, Earth-size worlds.*

Following up on the Spitzer discovery, NASA's Hubble Space Telescope has initiated the screening of four of the planets, including the three inside the habitable zone. Associate administrator of NASA's Science Mission Directorate in Washington, **Thomas Zurbuchen**, said in a statement:

> *This discovery could be a significant piece in the puzzle of finding habitable environments, places that are conducive to life. Answering the question 'are we alone' is a top science priority and finding so many planets like these for the first time in the habitable zone is a remarkable step forward toward that goal.*

The first scientific detection of an exoplanet was in 1988. However, the first confirmed detection came in 1992; since then, and as of 22 February 2017, there have been 3,583 exoplanets in 2,688 planetary systems and 603 multiple planetary systems confirmed.

What would life be like near TRAPPIST-1?

Lisa Kaltenegger – director of the Carl Sagan Institute at Cornell University – is an expert on exoplanets and their potential to support life beyond Earth. She happens to have two papers completed that speak to this subject – one under review at Monthly Notices of the Royal Society, and one forthcoming in The Astrophysical Journal. Both discuss life under a very high ultraviolet radiation flux environment. Kaltenegger said in a statement on February 22, 2017:

> *Finding multiple planets in the habitable zone of their host star is a great discovery because it means there can be even more potentially habitable planets per star than we thought. And finding more rocky planets in the habitable zone per star definitely increases our odds of finding life. Trappist-1 now holds the record for the most rocky planets in the habitable zone – our solar system only has two – Earth and Mars.* ***Life is a definite possibility on these worlds, but it might look different because there's likely to be very high ultraviolet radiation flux on the surface of these planets****.*
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> *How good or bad would such a UV environment be for life? Our paper, currently under review at Monthly Notices of the Royal Society, discusses just this scenario for the Trappist-1 system, examining the consequences of different atmospheres for life in a UV environment.*
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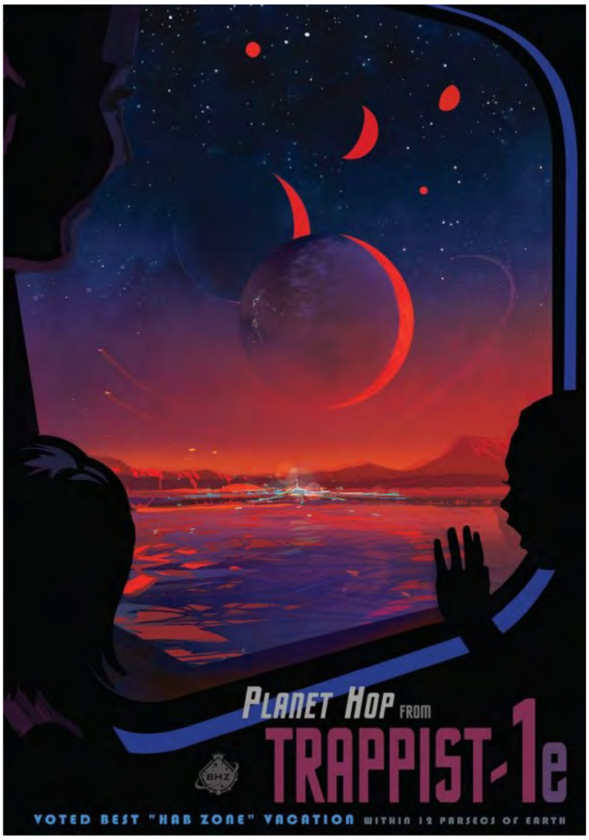
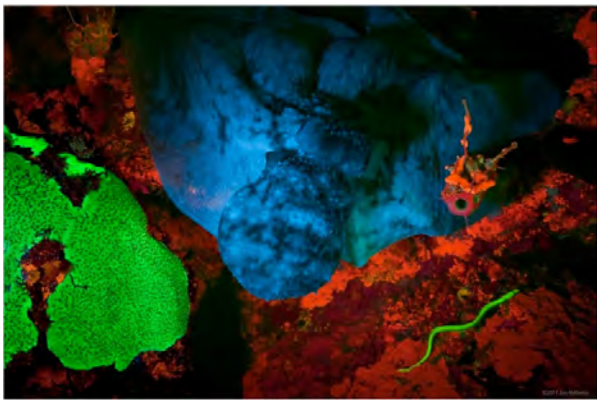
> *We find that if the star is active, as indicated by the X-ray flux, then planets need an ozone layer to shield their surface from the harsh UV that would sterilize the surface. If the planets around Trappist-1 do not have an ozone layer (like a young Earth), life would need to shelter underground or in an ocean to survive and/or develop strategies to shield itself from the UV, such as biofluorescence*



This poster imagines what a future trip to TRAPPIST-1e might be like. Could future visitors from Earth to this world expect to find life?

Biofluorescence is the absorption of electromagnetic wavelengths from the visible light spectrum by fluorescent proteins in a living organism, and the reemission of that light at a lower energy level. This causes the light that is re-emitted to be a different colour than the light that is absorbed. Stimulating light excites an electron, raising energy to an unstable level. This instability is unfavourable, so the energized electron is returned to a stable state almost as immediately as it becomes unstable. This return to stability corresponds with the release of excess energy in the form of fluorescent light. This emission of light is only observable when the stimulant light is still providing light to the organism/object and is typically yellow, pink, orange, red, green, or purple. Biofluorescence is not to be confused with other following forms of biotic light, such as bioluminescence and biophosphorescence.



Water absorbs light of long wavelengths, so less light from these wavelengths reflects back to reach the eye. Therefore, warm colours from the visual light spectrum appear less vibrant at increasing depths. Light intensity decreases 10 fold with every 75 m of depth, so at depths of 75 m, light is 10% as intense as it is on the surface, and is only 1% as intense at 150 m as it is on the surface. Because the water filters out the wavelengths and intensity of water reaching certain depths, different proteins, because of the wavelengths and intensities of light they are capable of absorbing, are better suited to different depths. Theoretically, some fish eyes can detect light as deep as 1000m. At these depths of the aphotic zone, the only sources of light are organisms themselves, giving off light through chemical reactions in a process called bioluminescence.

We may soon be able to detect atmospheric biosignatures such as methane, indicating adaptations by life, with the James Webb Space Telescope, launching in 2018, or the European Extremely Large Telescope, coming online in 2022.

AK, with EarthSky and Wikipedia Notes