Astrobiology News November 2021:
New Frontiers in Astrobiology: The *James Webb Space Telescope* and Beyond

Scheduled to launch on December 18, 2021 from French Guiana, the *James Webb Space Telescope* (JWST), the long awaited successor to the *Hubble Space Telescope*, is the result of a more than two-decade-long collaboration between NASA, the European Space Agency, and the Canadian Space Agency. The 18 hexagonal, gold-coated beryllium sections that make up JWST's 6.5-meter primary mirror will unfold as part of a complex series of maneuvers during the observatory's 29-day journey enroute to a point in space about one million miles from Earth, where gravity will keep the observatory almost stationary relative to the Earth and Sun.

JWST was originally designed to study the oldest galaxies in the Universe and was scheduled to launch in 2007. The 14-year delay, together with the increasing number of exoplanet discoveries during the intervening years, has also positioned the study of exoplanets high on the list of its science priorities. JWST's instruments detect light in the near- and mid-infrared parts of the spectrum, which make them ideal for studying faraway galaxies, and also for identifying several molecules that may be key to life on other planets.[1] Using a technique known as transit spectroscopy, JWST will observe exoplanets that pass in front of their stars, in order to identify molecules in the atmospheres of these exoplanets by the characteristic patterns the molecules produce as they absorb light from the stars. Although this technique has been used by both space-based and ground-based telescopes for years, JWST will be the first to make these measurements in the mid-infrared, which will enable it to identify molecules such as carbon dioxide, methane, water, and ammonia, which could indicate whether an exoplanet is able to, or does, support life.

Identifying habitable Earth-like worlds and searching for the biochemical signatures of life was identified as one of the top three priorities in the Decadal Survey on Astronomy and Astrophysics 2020 (Astro2020),[2] which was released to the public on November 4, 2021.[3] JWST is a major step in this direction. Due to its physical constraints, however, JWST will only be able to study exoplanets very close to their stars. This doesn't preclude the detection of habitable conditions on exoplanets that orbit cool stars; however, future missions will be needed to identify exoplanets that are truly like Earth. To this end, Astro2020 calls for the launch of a massive space-based observatory in the mid-2040s.[4] The main priority of this hypothetical space observatory would be to search for signs of life on 25 exoplanets that orbit in their stars' habitable zones and have been deemed "Earth-like."

Meanwhile, NASA has called for a new framework for understanding the significance of new scientific results relating to the search for life.[5] They propose a seven-level scale that would measure how close we are in terms of the search for life in particular locations, and in terms of the required technologies. The idea is to move beyond the binary "it's life" or "it's not life" options. Mary Voytek, head of NASA's Astrobiology Program at NASA Headquarters in Washington says, "We

[1] https://cen.acs.org/physical-chemistry/astrochemistry/James-Webb-Space-Telescope-astrochemistsnewest/99/i41
[2] https://www.nationalacademies.org/our-work/decadal-survey-on-astronomy-and-astrophysics-2020-astro2020
[3] https://nap.edu/resource/26141/interactive/
[4] https://www.salon.com/2021/11/06/astronomy-ten-year-plan-exoplanets/
[5] https://www.nasa.gov/feature/are-we-alone-in-the-universe-nasa-calls-for-new-framework

need a better way to share the excitement of our discoveries, and demonstrate how each discovery builds on the next, so that we can bring the public and other scientists along on the journey."

To learn more about how JWST will contribute to this journey, please join us on December 1, 2021 at 5 pm Central Standard Time, when Dr. Heidi Hammel, Interdisciplinary Scientist for the JWST, will present a CASIRAS webinar with the provocative title, "Will the James Webb Telescope See God?"[6] Register[7] to get the free zoom link and tune in to hear Dr. Hammel's take on this question!

Until next month,

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[6] https://www.casiras.org/2021/11/10/will-the-james-webb-telescope-see-god-a-casiras-webinar-with-heidi-b-hammel/
[7] https://www.lstc.edu/news-events/events/casiras-lecture