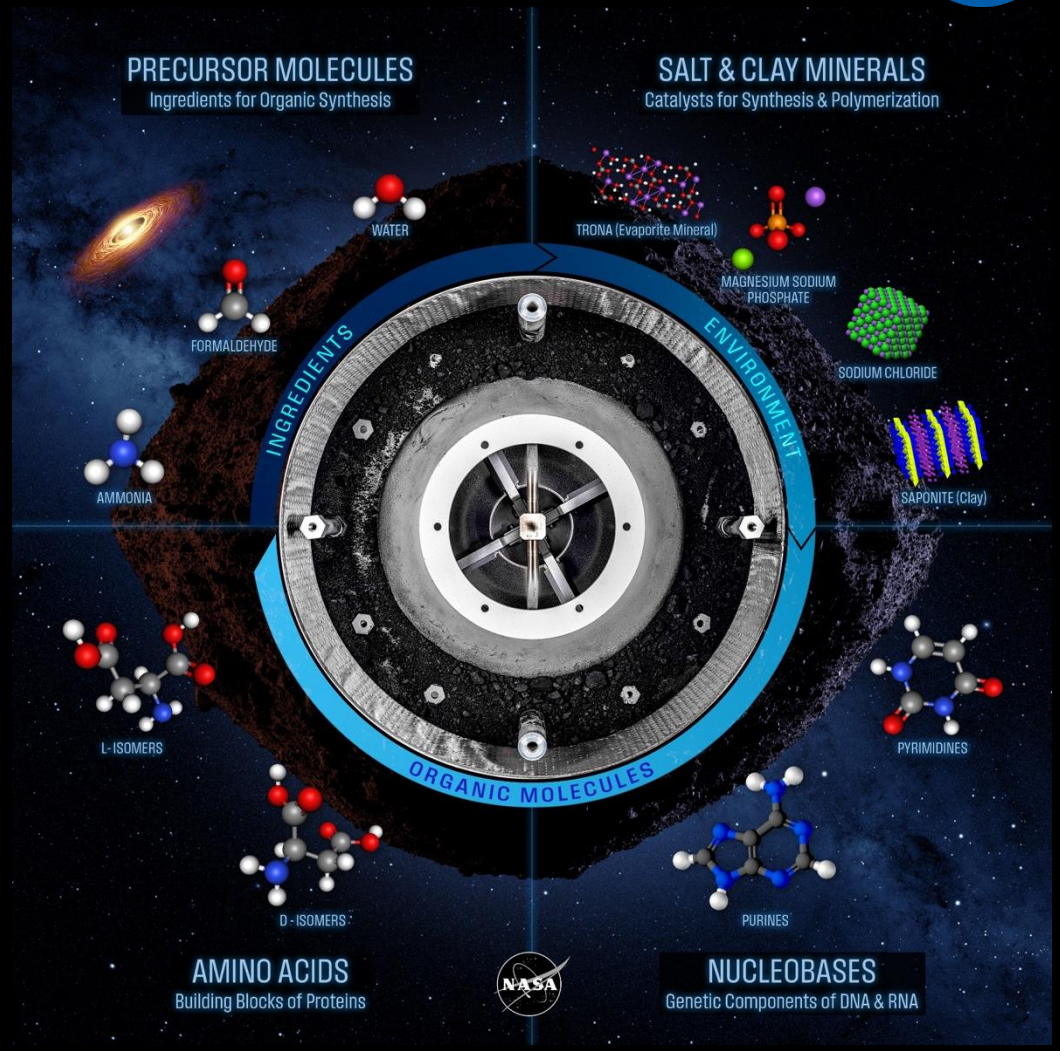
Ancient Brines and the Chemical Building Blocks of Life in Asteroid Bennu

After studying samples from asteroid Bennu delivered to Earth by NASA's OSIRIS-REx mission in September 2023, scientists published two papers in the journals Nature and Nature Astronomy highlighting new results on the composition of minerals, salts and organics in the samples, respectively.

In addition to abundant water-rich clay minerals, scientists found a unique sequence of salt minerals including sodium phosphates, and sodium-rich carbonates, sulfates, chlorides and fluorides that formed during evaporation of a late-stage brine that existed ~4.5 billion years ago in Bennu's parent body. The discovery of brines on early Bennu provides a unique insight into the geological evolution of icy bodies and environments that would have been very favorable for prebiotic chemistry.

The Bennu samples contained all five of the nucleobases that are the genetic components of DNA and RNA, and 14 of the 20 amino acids that life uses to build proteins. Scientists also found a surprisingly high abundance of nitrogen in the form of ammonia, which plays a key role in the formation of amino acids and nucleobases and is a catalyst in many biochemical reactions.

These findings support the hypothesis that Bennu comes from an ancient wet world, that included material sourced from the coldest regions of the solar system, likely beyond the orbit of Saturn. Based on similarities between Bennu's composition and other icy bodies in the solar system such as Ceres and Enceladus, these life-supporting conditions could be widespread across the solar system (and beyond), indicating that life could have readily emerged on other worlds beyond Earth.



This figure illustrates the key molecules and minerals discovered in samples of near-Earth asteroid (101955) Bennu, which were delivered to Earth by NASA's OSIRIS-REx mission in September 2023. Credit: NASA/Goddard//OSIRIS-REx/Dan Gallagher

Glavin and Dworkin *et al.* 2025 *Nature Astronomy* https://doi.org/10.1038/s41550-024-02479-9
McCoy and Russell *et al.* 2025 *Nature* https://doi.org/10.1038/s41586-024-08495-6