

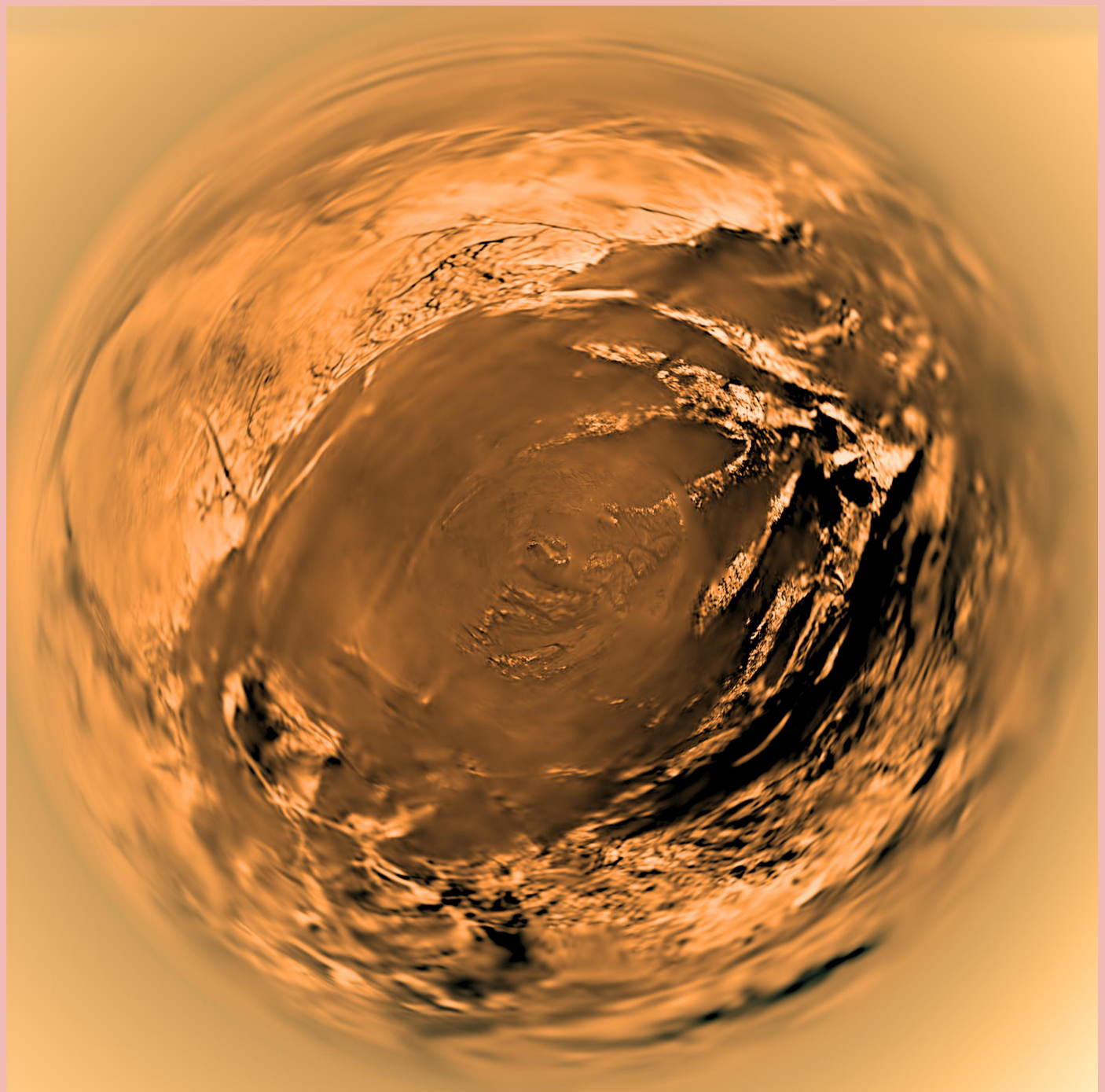
LIFE ELSEWHERE?

Humans have been speculating about life on other planets for two millenia. Most scientists are convinced that life existing elsewhere is a logical conclusion given the enormity of the Universe and its age. We define life as an organism that has cellular organization, can grow, reproduce, react to its surroundings, and maintain homeostasis—internal conditions separate from the outside environment. All Earth organisms are composed of hydrogen-carbon chain molecules. These molecules, or biomarkers, can be preserved in the rock record after death and are the most reliable clues to evidence of life in Earth's past. To search for fossil extraterrestrial life, we should be able to look for its biomarkers.

There are many things about Earth that has allowed life to evolve here. To find life elsewhere in the universe, we need to look for these same characteristics.

- Our distance away from the center of our galaxy prevents us from having negative interference from other solar systems, comets, gamma ray bursts, supernovae, black holes, etc.—all potential life-sterilization events. Too far away from the center of a galaxy and there aren't enough heavy elements to form rocky planets.
- Our solar system, thanks to the size of our star, has provided us a place to evolve for 4.6 billion years to date, with a constant, stable source of energy. Year after year, that energy increases as the Sun burns brighter. We have another 1 billion years before the Sun's burning energy will be too hot to support life on Earth. Smaller stars could provide even longer planet lifetimes, but with less energy emission. Larger stars would burn out and explode too early. Our Sun's size has given us time for intelligent life to evolve from single-celled bacteria.
- The gaseous planets in our solar system are not so big that they prevent rocky planets from forming.
- The close proximity of Jupiter keeps most asteroids and comets from colliding with our surface and, thus, devastating living organisms on its surface.
- Our gravity is strong enough to keep our atmosphere from escaping to space, but weak enough to enable free movement of life on our surface.
- Earth has an adequate supply of carbon, oxygen, hydrogen, phosphorous, sulfur, calcium, and other important life-building elements, without poisonous chemicals like ammonia and methane in our atmospheres and oceans.
- We have a protective ozone layer to screen out the sun's harmful UV radiation and a magnetic field to deflect cosmic high-energy particles.
- Liquid water on Earth's surface has been an essential ingredient for life as we know it. Our water came originally from colliding comets and volcanic outgassing of the interior—from the original meteoric material that accreted to form Earth.
- Thanks to plate tectonics and its steady supply of carbon dioxide, as well as our proximity to the Sun, we have had stable temperatures throughout our history. The range of temperatures experienced with the seasons and cyclic climate change is narrow—only 2% of the range found within our entire Solar System.

Titan, a moon of Saturn, is a good candidate for having life. It has a similar atmospheric composition and pressure to Earth's as well as similar surface gravity and temperature. NASA is currently exploring Titan's atmosphere and surface with remote probes.



You're the first spacecraft ever to descend to Titan—what do you see? Immediately after the Huygen probe pierced the cloud deck of Saturn's moon Titan January 14, 2005, it took a unique series of pictures of one of the Solar System's most mysterious moons. Pictured above is a panoramic fisheye view Huygen obtained from about five kilometers above Titan's surface. The digital projection makes the local surface, mostly flat, appear as a ball, but allows one to see in all directions. Huygen eventually landed in the large dark area in the center—an area named Xanadu. This relatively featureless, dark, sandy basin appears to be surrounded by light colored hills to the right and a landscape fractured by streams and canyons above. Recent evidence indicates that Titan's lakebeds and streambeds are usually dry but sometimes filled with flash floods of liquid methane from rare torrents of methane rain. Header Image also of Titan. NASA ©