Search for alien life challenges current concepts, says U. of Colorado prof.

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For scientists eying distant planets and solar systems for signs of alien activity, University of Colorado at Boulder Professor Carol Cleland suggests the first order of business is to keep an open mind.

It may be a mistake to try to define life, given such definitions are based on a single example -- life on Earth, said Cleland, a philosophy professor and fellow at the NASA-funded CU-Boulder Center for Astrobiology. The best strategy is probably to develop a "general theory of living systems," she said.

Many biologists agree the best definition of living systems today is the "chemical Darwinian definition" involving self-sustaining chemical systems that undergo evolution at the molecular level, she said. But the theory is limited in that life on Earth probably resulted from physical and chemical "contingencies" present at the time of its origin on the planet.

"What we really need to do is to search for physical systems that challenge our current concept of life, systems that both resemble familiar life and differ from it in provocative ways," she said. Cleland participated in an astrobiology symposium at the annual American Association for the Advancement of Science meeting held in St. Louis Feb. 16 to Feb. 20.

In 1976, for example, NASA's Viking 1 spacecraft conducted automated biology experiments on Mars by mixing soil samples with radioactively

labeled nutrients to determine if metabolic "burps" from possible extraterrestrial microbes could be detected, she said. Although positive readings convinced at least some team scientists that life was present, a subsequent investigation by a second Viking instrument failed to find evidence of organic molecules on the planet's surface.

"Initially, the scientists were ready to break out the champagne," said Cleland. "But because subsequent investigations yielded baffling results that didn't fit the original metabolic definition of life they were working with, NASA eventually concluded the original signal was not evidence of life. This is an experiment that is still debated today, and it's a classic example of an anomaly."

Although there are more than 100 combinations of nucleic acids in nature, terrestrial life constructs all of its proteins from only about 20 of them, suggesting a single origin for life on Earth, said Cleland. "It's very difficult to generalize about life based on just one example," she said.

An article by Cleland and CU-Boulder molecular, cellular and developmental biology Professor Shelley Copley, published online in the Jan. 16 International Journal of Astrobiology, explores the idea that an "alternative microbial life" may exist on Earth. Such a "shadow biosphere" could have a different molecular architecture and biochemistry than known life and would be undetectable with current techniques like microscopy, cell cultivation and Polymerase Chain Reaction amplification, the authors wrote.

Despite new suites of sophisticated instruments developed in recent years, the ability of scientists to detect life on Mars or in another solar system is probably very limited, Cleland said. "If the DNA in an alien organism was even slightly different than the DNA in life on Earth, with a different suite of nucleotide bases to encode genetic information, we probably wouldn't be able to recognize it. "

So what might be out there? "It's not too far-fetched to imagine an alien microbe whose genetic material directly and adaptively changes in response to different environmental conditions," said Cleland. "Instead of looking for life as we know it, scientists may be better served to look for anomalies, which amounts to looking for life as we don't know it."

In the past decade, scientists have discovered more than 170 new planets around other stars, a number that seems to grow by the month due to clever new planet-hunting techniques, Cleland said. In the future, astrobiologists surveying other planets will no doubt encounter non-living systems that are "really weird," she said.

"In such cases, it probably is best to suspend judgment," she said. "The great strength of science is its tentativeness, and through history, it has been the careful analysis of anomalies that have eventually changed scientific paradigms."

Source: University of Colorado at Boulder