Astrobiology : The Search for Life in the Universe

September 30 - November 6, 2013

Overview: This is a 20-hour honors-level course in astrobiology taught within the UP Department of Physics. This course will provide a broad overview of the young field of astrobiology, from its origins to current topics of research. There will be an emphasis on reading original research papers in the field.

Perhaps the most important large question facing astronomers today is "Are we alone?" To answer this question, we must know: is the Earth unique? Is the solar system unique? Is our galaxy unique? And is life itself unique? These are questions that researchers have only begun to answer, yet are important, approachable, and relevant to society today.

Astrobiology is one of NASA's key areas of research today. Interest in astrobiology has driven many NASA missions, including over a dozen spacecraft sent to Mars within the last 15 years, and many searches for exoplanets. Additional studies have yielded new insight into the origins of life, and the diversity of Earth's life in extreme environments. While no current work has detected any clear evidence for life elsewhere, is it possible that we simply do not recognize life when we see it?

Required background: General familiarity with introductory physics and calculus. Although offered at the honors level, this course will be broad and interdisciplinary, covering aspects of astronomy, biology, geology, and physics.

Course outline:

1. What is astrobiology? Definitions and scope.
2. Background: Scale of the universe. Scale of time.
3. What does life need? Extremophiles on Earth.
4. Origins of life. History of life on Earth. Tree of life. RNA.
5. Solar System: Mars. Curiosity and Viking searches for life.
6. Solar System: Enceladus, Europa, and Titan.
7. Exoplanets: How to search for them, and search biases.
8. Exoplanets: Could they support life?
9. What would alien life look like? Philosophy and policy.
10. Can life find us? SETI.
11. Rare Earth hypothesis.

Instructor: Dr. Henry Throop is a Visiting Senior Lecturer in the Department of Physics, University of Pretoria, and a Senior Scientist with the Planetary Science Institute in Tucson, Arizona, USA. He received a PhD in Planetary Science from the University of Colorado, USA, in 2000. His work focuses on the outer solar system, and he has published over 40 articles in scientific journals, on topics ranging from to rings of Saturn and Jupiter, to planet and star formation, to the formation of the chemical building blocks of life, to searching for (and co-discovering) Pluto's smallest moon, Styx, in 2012. He is a frequent consultant to the US's NASA and the National Science Foundation. While working at NASA, he was responsible for the management of two of NASA's major scientific research programs. Throop's work has been featured in Science, Nature, Time, The Washington Post, and on SABC Morning Live, the History Channel and National Geographic TV.
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Course dates:
September 30; October 2, 4, 21, 22, 28, 30; November 1, 4, 6
Time: 09h00 - 11h00, Natural Sciences 1, Lecture Hall 5-31.