Astrobiology: past, present, and future

The Astrobiology theme at the Pufendorf Institute

The theme, or programme, at the Pufendorf Institute aims at strengthening and further developing research at Lund University related to astrobiology. Astrobiology is not "owned" by any specific discipline or faculty, and is a research field that demands interdisciplinary cooperation that goes beyond traditional disciplinary boundaries. The programme aims to strengthen both research and education in astrobiology at Lund University and further involves the third mission, with dissemination of knowledge of through public communication and engagement, in the form of popular science articles, lectures and through media communication. Astrobiology draws much interest among the public!

Research questions

Astronomy:

Hundreds of planets have been discovered around other stars than our own sun, and it is expected that thousands of other exoplanets will be found during the next few years. Which of these have the right conditions for sustaining life—at least Earth-like forms of life? How common is liquid water and a climate that remains stable over millions of years?

Geology:

The basis for our knowledge about the emergence and evolution of life lies within the geological fields of palaeontology and sedimentology; the geological archive documents early life on Earth. Traces of early life, even before fossils, are traces of stable coal and oxygen isotopes, as documented by studies of the oldest sedimentary rocks. An important question treats the role of oxygen for the emergence of multicellular life. Early cyanobacteria were photosynthetic and important for the transformation of the atmosphere more than 3 billion years ago. Subsequently, when land plants spread across the surface of the Earth over 400 million years ago, the composition of the atmosphere changed further, a topic studied by a research group here in Lund. Geological processes such as volcanism and erosion occurs both on Earth and other planets, and an analysis of differences and similarities can give clues to the mechanisms of these processes. Space probes have discovered structures that differ from those on Earth, for example volcanoes on Venus that exist without continental drift. Moons around Jupiter contain oceans of water in liquid form due to tidal power. For this no solar heat is needed, but can this create favourable conditions for life?

Biology:

What is "life" and would we be able to recognise it if it was very different from earthly life forms as we know them today? On, and inside, Earth we have now discovered the existence of "primitive" life forms in extreme environments. Dried or frozen spores seem to be able to survive long periods of time, perhaps long enough to be able to be transferred between different planets. How did the earliest life on Earth evolve? Did it arise once or many times? What role did the oxygen content of the atmosphere play? What qualities of life can be reproduced artificially? Must life be carbon based? It could be relevant to ask the question if we with materials such as Silicon compound semiconductors or complex oxide materials could create life-like behaviour and objects.

Medicine:

Human space travel entails a number of challenging problems. How do we cope with high doses of cosmic radiation, what are the effects of long periods of weightlessness? Engineering. How to design spacecrafts and space stations so as to minimize medical and social problems for the crew? Space travelling raises many technical problems, and needs further development of our computer technology and robotics. With robotics we mean an autonomous functionality of any instrumentation or device sent into space. Research and studies in this subject is fundamental for any exploration as well as the further manned exploration, which will need support of the crew by service robots in a more general way. For the Mars missions, earth-based labs simulating conditions on Mars has been created. So simulating life-like processes in extreme environments and new materials can be performed.

The Humanities:

Several themes are already being discussed at various departments at Lund University, such as the history of astrobiology, ethical and existential problems in connection with future contact with alien civilization and possible future space colonies. What are the social, cultural and political aspects of extraterrestrial life as portrayed in popularizations and science fiction? How to best construct or interpret interstellar messages?

Theology:

In theology, one relevant theme is what effect a future discovery of extraterrestrial life would have for the monotheistic religions? From the perspective of religious studies it is also relevant to examine the similarities between accounts of highly evolved extraterrestrials within popular culture and traditional religious myths. What do such accounts tell us about our own society and culture?

Background

Astrobiology is a rapidly growing multidisciplinary research field at the intersection of astronomy, biology, and the geosciences. Researchers within the field study both theoretical and empirical questions concerning planet formation and the existence of exoplanets in distant solar systems, the emergence of life, the existence of life in extreme environments etc. Probes have explored the surface of Mars searching for traces of life, and radio telescopes have searched for radio signals from other civilisations. Today we know more than 400 exoplanets. On Earth, life exists even in the most extreme environments, such as deep down in the bedrock and under the ice of Antarctica. Having long been rather controversial, the field has started to acquire a more established form: recently, journals, conferences, textbooks, courses, and scientific organisations devoted to this multidisciplinary field have emerged.

Astrobiology does not only involve the natural sciences; the field also raises many questions of interest to the humanities and social sciences. The existence of extraterrestrial life and related questions such as what “life” really is and what circumstances are needed for life, have a long history. Before scientific tools existed in this field, the topic of life outside of Earth was instead analyzed with religious, literary and philosophical argumentation. Historians of science and ideas, philosophers, anthropologists, theologians, sociologists, literary scholars, media researchers and others, have studied what qualities humans have ascribed to extraterrestrial life in different times and contexts. What ethical implications are there to a future discovery of extraterrestrial life? How can we communicate with extraterrestrial civilizations?
What is the history of astrobiology? How has extraterrestrial life been presented in the popular culture?

Researchers within the Astrobiology Theme

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Activities

Check out the Astrobiology blog!
Astrobiologyblog

Symposiums:

Enigmas in the Evolution of Life

Symposium arranged by the research theme “Astrobiology: Past, Present, and Future"

Friday October 21, 2011, Palaestra

Program

The History and Philosophy of Astrobiology
Time: September 27-28, 2011
Venue:Spirit of Hven Backafallsbyn, Hven

The Pufendorf IAS research program in astrobiology now invite abstracts for oral or poster presentations.

Program

News:

Pufendorf IAS presents Symposium on Exoplanets May 13 - Now on iTunesU. Talks byDavid Dunér, Eric Gaidos, Gustav Holmberg, Dainis Dravins, Uffe Gråe Jörgensen, Anders Johansen, Ansgar Reiners, Melvyn Davies, Malcolm Fridlund

Do you have communication problems?

Follow these lectures on interstellar communication held at the Pufendorf Institute at Lund University, May 5. Now on iTunesU. Talks by David Dunér, William Macauley, Michael Arbib, Göran Sonesson, Arthur Holmer and Håkan Lidbo.

"Internationella möten om astrobiologi i Lund" - European Space Agency, April 7
Read article

"Jakten på annat Liv"Astrobiologyproject in Fokus March 17 2011
Read article

"Liv i rymden spränger gränser", "Naturvetarna" presenting the Astrobiologypoject, 27th of January 2011
Read article

We welcome Astrobiology - the new theme at the Pufendorf IAS!
Inauguration 12 October

"Nasa receives help from Sweden"
Read article

European Space Agency on "Ambitious Astrobiology Project"
Read article

Populär Astronomi gives us "Facts on the UN and Aliens"
Read article

Rymdkanalen blogs on the Pufendorf Astrobiology project
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