ASTROBIOLOGY, SUSTAINABILITY, AND OUTREACH. Jacob Haqq-Misra, Department of Meteorology, The Pennsylvania State University (407 Walker Building, University Park, PA 16802, misra@meteo.psu.edu).

Introduction: Astrobiology has wide appeal not only across a broad range of scientific disciplines but also to the general public. In particular, the steady discovery of extrasolar planets and the ongoing search for extraterrestrial intelligence capture the public's imagination as to what might lay beyond Earth, even though these efforts comprise a small component of scientific effort today. Although imaginative, speculative, and philosophical topics are often absent from scientific discourse, they provide a valuable tool to engage the non-scientific public in discussion and highlight contemporary issues facing the world today.

Discussion: One of the greatest uncertainties for the future of humanity is our ability to limit population growth and successfully transition to a sustainable development. When the rate of resource consumption exceeds replenishment, as it does on a global scale today, then the resulting unsustainable development cannot persist for an indefinite period of time. Critics may be undaunted by this prospect of collapse because the timescales in question are greater than a human generation or because of belief in the power of human technology to overcome such obstacles. However, the problem of sustainability can be made even more poignant in the context of galactic expansion: perhaps the conspicuous absence of extraterrestrials (known as the Fermi paradox) can be explained by the fact that exponential growth is an unsustainable development pattern even for intelligent civilizations [1]. We may never see an expansive extraterrestrial civilization, for they would expand and collapse on timescales too short to notice, while slower-growth extraterrestrials have had insufficient time to traverse the galaxy. Thus, the absence of extraterrestrial observations also provides a lesson for humanity, as both a warning to avoid unsustainable collapse and a challenge to ensure our long-term survival.

The discovery of extrasolar planets may also question the worldview of the religious and secular public, especially as future missions are developed to observe potential biosignatures in the atmospheres of habitable worlds [2]. For example, the belief in human entitlement to the resources of Earth and beyond is reinforced by religious doctrine that requires the theological separation of humanity from the biosphere and also by humanist thought that cites technological achievements as an indicator that humanity is the superior form of life [3]. While the discovery of new planets or strong biosignatures cannot conclusively demonstrate the presence of extraterrestrial life, these discoveries will direct public discussion toward merging scientific discovery with deeply-held beliefs.

Public outreach of scientific knowledge is generally limited in extent to schools, universities, and museums, where most of the public attendees already have an interest in science. A greater challenge arises when attempting to reach out to the public sector that almost never interfaces with the communities of science and education. As one method of approaching the non-scientific public, the philosophical novel *Planetary Messenger* [4] has been an effective tool to broach a range of interdisciplinary topics and connect scientific knowledge to the reader's own personal world view. So far, *Planetary Messenger* has been used in high schools, churches, and music festivals to introduce astrobiological topics in a socially relevant context. By framing the search for life within the broader themes of epistemology, spirituality, sustainability, and entitlement, the reader is able to glean important contributions from astrobiology that relate to the world today.

Summary: The astrobiological search for life has significant implications for the long-term sustainability of life on Earth by viewing humanity in the context of the biosphere. However, a large sector of the public remains absent from outreach activities, primarily because these individuals are distanced from schools, museums, and other educational institutions. Novel outreach techniques that span a range of scientific and philosophical topics are therefore necessary in order to approach the broader public in a relevant way.

References: [1] Haqq-Misra J. D. and Baum S. D. (2009) *JBIS, 62,* 47-51. [2] Des Marais D. J. et al. (2002) *Astrobiology, 2,* 153-181. [3] Haqq-Misra J. D. (2007) *Astrobiology, 7,* 712-713. [4] Haqq-Misra J. D. (2009) *Planetary Messenger,* Createspace.