



Life in the cold: Implications for astrobiological exploration

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Astrobiology is the study of the origin, evolution, distribution, and future of life in the Universe. Advancing the NASA Astrobiology Institute's (NAI) approach to interdisciplinary science, the NAI's members have identified a major research theme integrating the study of microbial systems from molecular to ecological scales. Within that focus, at the forefront are studies of the lifestyles and impacts of cold-adapted, cold-tolerant, and cold-loving organisms. This presentation will focus primarily on work from two of the NAI's (current) sixteen Teams. At the University of Washington, Deming's laboratory is developing innovative techniques for the study of natural and artificial winter sea ice and the organisms entrained and surviving within it. They are investigating the impact of the microbes on the structure of the ice, and the influence of different temperature/pressure/salt effects. At Michigan State University, Tiedje and his colleagues are active in the analysis of environmental samples from arctic and Antarctic permafrost. Their work incorporates genomic, proteomic, and metabolomic studies of both *Psychrobacter* species and *Exiguobacterium* strains, and reveals that both gene acquisition and gene evolution provide a variety of adaptations for subzero life. Both temperature and salinity affect differential regulation of proteins. In addition to these focal technical presentations, we will also briefly present a selection of other NAI work relevant to low temperature biology and the exploration of Mars and Europa. The most promising areas for biology to arise or survive in our Solar System are extremely cold; an important consideration as we search for signs of life, extinct or extant. This observation is also important to bear in mind in assessing planetary protection guidelines and procedures.