JPL SURP Strategic Topic Areas - 2008

Topic Area:	1. To Advance Solar System Exploration in New Directions: To Understand Planetary Formation and Evolutionary Pathways, and to Seek, Discover and Inventory the Organic Materials in the Solar System and Elucidate Their Origins
Champion(s):	Arthur L. Lane – (818) 354-2725 [Arthur.L.Lane@jpl.nasa.gov] Patricia M. Beauchamp – (818) 354-0529 [Patricia.M.Beauchamp@jpl.nasa.gov] Sabrina Feldman – (818) 393-2327 [Sabrina.M.Feldman@jpl.nasa.gov]

The pursuit of knowledge about the prevalence of life in the universe and how human beings fit into the grand scheme of the cosmos is now a highly visible, compelling enterprise for NASA, NSF and science agencies throughout the world. Within this broad endeavor, JPL's activities can be classed into two principal thrusts: Solar System exploration (the environs of our local star, the Sun) and the identification and categorization of planets around other star systems within our local arm of the Milky Way galaxy. For both of these thrusts there are concurrent scientific investigations and engineering/technical advancements operating on many levels: theory and modeling, astronomical observations, laboratory emulation and terrestrial field studies, instrument development and spaceflight missions to bodies in our Solar System and examination at exquisite spatial resolutions the environs of nearby star systems. We propose an ambitious program of Solar System exploration focused on inventorying the organic materials in the solar system and elucidating their origins by the year 2036, marking JPL's 100th Anniversary. This strategic challenge endeavor goes significantly beyond JPL's current visions for its R&TD and DRDF programs, and will provide a unifying focus for future missions to Mars, Europa, Titan, Endeladus, comets, asteroids, and other solar system bodies. The development of a cogent, well structured set of investigations for determining the nature and abundance of organic materials throughout the solar system promises to dramatically enhance our understanding of the history and fate of organic molecules in varying planetary environments, and could plausibly lead to the discovery of past or present life on another planetary body.

This strategic challenge will provide a unifying focus for many existing research threads at JPL, and can suggest areas for future investment, including but not limited to: instrumentation for organic molecule assessment, definition of organic biomarkers, planetary ice studies (especially those that examine the synthesis of precursor organic materials within icy environments), Titan surface chemistry and atmosphere modeling, geochemical properties of Europa, vent chemistry on Enceladus, diagenetic alteration of planetary materials, hydrological / geochemical history of Mars, hydrothermal vent modeling and field research, design of comet / asteroid sample return missions, planetary mobility requirements (horizontal and vertical) in order to access samples with preserved organic materials, sample acquisition and pristine transport strategies, etc.

There are many potential approaches and directions for creating a strategic challenge theme in Astrobiology that uses to best advantage the blending of JPL talent and institutional capabilities with the intellectual resources that lie within the established strategic university alliances. Given the modest amounts of funding available to the strategic challenge effort, it is important to separate those areas where substantial external funding is already allocated to advancing specific topic areas and those areas where funding is limited or not currently available to test new and exciting concepts. It is in this latter area where the best yield for the strategic challenge investment may lie, not only for providing a foothold for the innovative concept, but for establishing new relationship networks between JPL and single or multiple strategic universities.

<u>Mechanics of the University/JPL proposal call:</u>

The following topic areas for research and investigation are of particular interest to JPL:

- Solar System formation processes, conditions that lead to pathways on different evolutionary tracks, conditions that lead to pre-biotic chemistry
- Theory/modeling of pre-biotic to biotic transition with connectivity to experimental verification
- Instrumentation concepts that may provide new methods for detecting organic material in planetary environments
- Laboratory demonstrations of new measurement techniques that provide sufficient sensitivity and specificity to be considered as possible pre-cursors to instrumentation development
- Laboratory approaches that examine the extreme limits (temperature, pressure, salinity, energy-starvation, ….) of cellular replication under conditions germane to our Solar System

- New approaches that enable verification of biological and/or organic material cleanliness for future life detection missions
- Study of chemical processes relevant to the icy environments found within the Solar System, such as at the outer planet icy satellites, cometary surfaces, and in the Mars polar domains
- Study of the physical characteristics of water ices that are admixed with known or suspected chemicals found in the outer solar systems, such as ammonia, methane, simple alcohols, nitrogen and its oxides, etc., and
- Concepts that would advance our understanding of the transformation of planetary environments into biologically habitable zones.

Each of these topic areas has connections to JPL's existing research and development base as well as representation in the academic community. In addition to requesting JPL-single university proposals, the proposal call will also encourage proposals involving JPL and dual universities or dual university departments. University directors of research will be encouraged to exchange with their counterparts, identify possible areas for triangular teaming and collaboration in order to generate broader proposals that may have a correspondingly larger funding allocation.