# Bioregenerative Life Support Road Mapping Workshop

**Marriott City Center, Raleigh, NC**
**November 4-5, 2009**

## DISCIPLINE TEAMS

*(Preliminary July 2009)*

### Crop Production Chamber Design and Operations

This group will focus on technologies needed for plant growth structures and materials, inflatable crop production systems, radiation shielding, techniques for soil less cultures, and crop lighting systems. This discussion group will also address technologies that can reduce the labor associated with horticultural tasks and optimize space utilization (e.g., mechanization and/or automation).

### Crop Environmental Physiology

This group will focus on technologies/research needed to optimize the crop growing environments within the energy, thermal, mass, and volume constraints of space. Areas of interest include atmospheric composition and pressure, light intensity and spectral quality, temperature, and humidity for candidate crops; effects of the accumulation of volatile organic compounds (e.g., ethylene) on crops; and water and nutrient use and recycling.

### Biological Approaches to Water and Waste Processing

This group will focus on technologies including reactors (aerobic and anaerobic) for processing solid and liquid wastes for nutrient, water, and materials recycling, as well as the potential for bio-gas (e.g., methane) and direct energy production. Waste streams would include inedible plant biomass, human solid waste, urine, food wastes, and packaging materials.

### Sensing, Simulation and Control for Crop Production

This group will focus on identifying the technologies needed for the sensing and control of key environment parameters, techniques in the simulation of crop production in space environments, advanced control algorithms for optimized crop production, and issues for integrating crop and biological processes with physico-chemical life support systems. Discussion will also include bio-engineered plant monitoring systems.

### Genetic Engineering and Breeding of Plants and Microbes

As our understanding of biological processes in cells and organisms improves, and as plant transformation techniques evolve, we will be able to new plants tailored for space exploration. With a systems biology approach in mind, this group will identify key traits, technologies and gaps in knowledge in the development of plants and microbes uniquely designed for advanced life support.

### Nutrition, Food Processing, and Food Storage Systems

This group will identify technologies/research and gaps in menu definition, nutritional assessment of in-situ produced foods, and impacts of menu choice on infrastructure requirements. If possible, we would also like to address dietary acceptability and bio-available anti-oxidants for radiation countermeasures. Many of the foods produced and processed will

require storage and the group will also address post harvest technologies needed to ensure the shelf-stable products in storage.

**Systems Integration, Closure and Testing**

This group will focus on the demonstration of the technologies in terrestrial analogs and identify key traits, technologies and gaps in knowledge (e.g., the US South Pole Station).This group will also discuss the theoretical maximum degree of food and material closure that can be achieved; horticultural testing of candidate crops (including any GMOs developed for use); establishing standard environmental conditions and what data to gather from the testing; sustained operational testing and risk/failure analysis; and equivalent system mass (i.e. power, mass, volume and crew time) considerations, especially related to lighting systems, which tend to drive the costs of crop production technology. The group will also consider the potential for gathering sociological/psychological data from terrestrial test beds where crops and humans exist in close proximity, and how these data might be factored into system trade studies.