STS-95

# Commercial Generic Bioprocessing Apparatus: Working to Bring Biology Research Into the Marketplace

The ability to support researchers from businesses and other ventures at all levels has been a priority for commercial space efforts, as has the ability to support a large number of small investigations. This important need has been met on several missions by the Commercial Generic Bioprocessing Apparatus (CGBA), a facility developed by BioServe Space Technologies, a NASA Commercial Space Center, that allows a variety of sophisticated bioprocessing research to be performed using a common device. On STS-95, research efforts cover eight major areas that will benefit Earth-based products ranging from the production of pharmaceuticals to fish hatcheries.

The heart of most CGBA investigations is a “microgravity test tube” called a Fluids Processing Apparatus (FPA), which is a glass barrel containing several chambers separated by rubber stoppers. Eight FPAs are placed together in a Group Activation Pack (GAP), which allows all of the research to be started simultaneously by turning a single crank. Eight GAPs, or similar-sized payloads, can be stored in a single CGBA temperature controlled locker, which now uses motor drives to automatically turn the cranks to start and stop experiments.

Courtesy: BioServe Space Technologies

*The Fluids Processing Apparatus is essentially a “microgravity test tube” that allows a variety of complex investigations to be performed in space.*

STS-95 will see two CGBA lockers being flown, supporting research in the following areas.

**Protein Crystals:** BioServe Space Technologies, the developer of the CGBA payload, is working with a small entrepreneurial partner, BioSpace International, Inc., to investigate methods of further enhancing the quality of space-grown crystals by actively monitoring and controlling the chemical environment surrounding the crystal.

**Antibiotic Production:** Previous CGBA research done in collaboration with Bristol-Myers Squibb revealed that the production of antibiotics by microorganisms increased in microgravity. To investigate this phenomenon, which could improve Earth-based production of antibiotics, the Gas Exchange Fermentation Apparatus (GEFA) has been integrated into CGBA to improve growth conditions and allow researchers to better understand the causes of the increased productivity.

**Bacterial Growth and Control:** For a number of reasons, the growth of bacteria is much more difficult to control in microgravity than it is on Earth. This series of investigations with industry partner Water

*Manual activation of 8 FPAs in an earlier version of the Group Activation Pack during a previous mission*

Technologies Corporation/WTC-Ecomaster will focus on the development of a new generation of purification resin beads. This work will benefit long-term human space operations, such as the International Space Station. It will also help answer the substantial need for improved Earth-based air and water disinfection systems, such as those used for emergencies or disaster relief efforts where safe drinking water is scarce.

**Cell Separation:** *Magnetospirillum magnetotacticum*, a species of bacteria, becomes magnetic as it synthesizes magnetite from the iron in its growth medium. In microgravity, researchers can sort or separate the cells by an applied magnetic field without the compounding effect of gravity-induced sedimentation acting on the cells. The data gathered from this investigation may improve, or provide a new way, of differentially separating cells, which in turn could benefit the field of immunology.

**Plant Products:** Plants grown in space exhibit differences from plants grown on the ground. This investigation, supported by Weyerhaeuser, AgrEvo USA, and Ocean Spray, will examine a suspected difference in the production of plant hormones, to learn if it may be possible to similarly manipulate this production on Earth. If it is possible to do so, it may allow researchers to develop varieties of fruits and vegetables that can have their ripening delayed or controlled during transport to market.

**Plant Science:** The ability of legume plants, such as beans, to form root nodules in a relationship with *Rhizobium*, a bacterium in the soil, allows them to obtain nitrogen from the air and soil. This ability means that the amount of fertilizer needed for these crops is reduced, cutting costs and helping the environment. Previous microgravity research indicates that it may be possible to get other types of plants, such as corn and wheat, to form these nodules as well, and investigators with Research Seeds, Inc., will attempt to do this. If successful, it could improve crop yields while reducing the need for fertilizer.

**Plant Research:** Plants grown in microgravity appear to produce less lignin, a structural material, than those grown on Earth. Another investigation in conjunction with Bristol-Myers Squibb will examine *Catharanthus roseus* plant cell cultures to see if the energy that normally goes into lignin production is redirected towards the production of anticancer compounds called vinca alkaloids. This research could lead to methods for enhancing the efficiency of growing plants used to produce pharmaceutical compounds.

**Aquaculture:** Previous research on the shuttle has shown that the development of brine shrimp was accelerated when initiated from rehydrated cysts (eggs). On STS-95, investigators affiliated with the Florida Aquaculture Association will see if this holds true for Tilapia and Killifish eggs as well. If so, further research will be done to determine the reason for this increase and to apply it to terrestrial fish hatcheries, which are becoming an increasingly important source for supplying the commercial demand for fish.

BioServe Space Technologies
George Morgenthaler, Director
Boulder, Colorado

National Aeronautics and
Space Administration

**George C. Marshall Space Flight Center**
Huntsville, Alabama

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