Supporting Health Research and Education

Commercial ITA Biomedical Experiments–2 (CIBX–2)

Experiments to seek solutions for a range of biomedical issues are at the heart of several investigations that will be hosted by the Commercial Instrumentation Technology Associates (ITA), Inc. Biomedical Experiments (CIBX–2) payload. CIBX–2 is unique, encompassing more than 20 separate experiments including cancer research, commercial experiments, and student hands-on experiments from 10 schools as part of ITA's ongoing University Among the Stars program.

ITA, in Exton, PA, has been a pioneer in commercial development of space ventures since 1982 by providing low-cost multi-user space hardware.

CIBX–2 uses the CIBX–1 hardware that flew aboard STS–95 in 1998. This hardware has spanned 19 microgravity missions (Space Shuttle, *Mir*, and Sounding Rocket Missions) starting in 1989. Since 1991, ITA has teamed with biotechnology scientists from universities and the private sector, to conduct its own corporate biomedical research in space. CIBX–2 experiments will support research in several health areas. For example, protein crystal growth experiments will address the structure of urokinase. Urokinase is a protein that has been identified as a key enzyme in the spread of brain, lung, colon, prostate, and breast cancers. In addition, crystals of the Bence Jones protein associated with bone cancer will also be grown. Understanding their structures may help scientists in developing treatments. In a related area, the Microencapsulation of Drugs (MEPS) is an anti-cancer drug delivery system, based on a 10-year partnership betweenNASA Johnson Space Center and ITA. On this mission, the co-encapsulation of antibodies and immune stimulants will be made in sub-micron microcapsules to target pulmonary and bacterial infections. Other investigations include the Regeneration of Nerve-cell Growth Factor in Micro-g by The Biospace Group of Huntsville, AL; Biofilm Formation, Southwest Texas State University; Effect of Zero-G on Bacteria and Crystal Growth Experiments, Milton Academy; EdVenture Lab Crystal Growth Experiments, The Challenger Center; Elementary Student Crystal Growth Experiments, Lockheed Martin; Muscle Cell Gene Expression, Brown University, and others.

Astronaut Story Musgrave activates the CMIX-5 (Commercial MDA ITA Experiment) payload in the Space Shuttle middeck during STS–80 in 1996. CIBX–2 is similar.

Student Mannix Aklian and ITA's Mark Bem prepare biological samples for flight as part of ITA's "hands-on" student outreach program on STS–95. Similar activities are a part of the CIBX–2 payload.

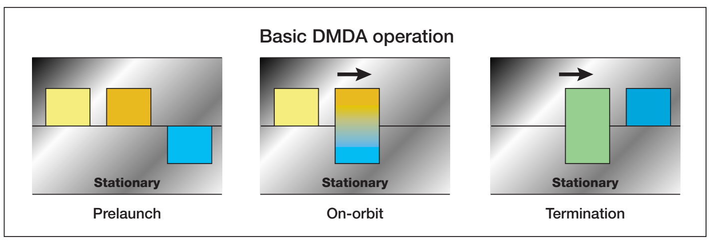
More than 3,000 students and 50 teachers nationally and internationally have been involved in ITA's University Among the Stars. This is a multi-disciplinary hands-on space education program that plays a positive role in students' lives by engaging them in a real-world experience of conducting their own scientific experiments in a microgravity environment. ITA has recently teamed with Space Outreach™, a non-profit organization, to expand this program. STS–107 will be the seventh Shuttle mission carrying ITA student experiments. This will also help train students of the next generation for the new century.

Commercial Space Company: Instrumentation Technology Associates (ITA), Inc., Exton, PA
Project Scientists: Dr. Dennis Morrison, NASA Johnson Space Center, Houston, TX; Dr. Allen Edmundson, Oklahoma Medical Research Foundation National Aeronautics and Space Administration

Background Information

Flight Hardware

CIBX–2 flight hardware comprises two sets of equipment, the Dual-Materials Dispersion Apparatus (DMDA) and the Liquids Mixing Apparatus (LMA). The DMDA is a multi-user space processing laboratory. It accommodates microgravity experiments in cell biology, thin film membrane casting, macromolecular and inorganic crystal growth, seed germination, collagen research, fluid sciences, and diffusion experiments, microencapsulation of drugs, and other biomedical and technical disciplines. The DMDA uses two blocks of inert materials with fluid wells machined into facing sides of the blocks. A single well on one block has one or two corresponding wells on the opposite block. The blocks are offset so each well on one block faces the inert wall of the other block. In space, the flight crew activates the DMDA and the blocks are repositioned to align the wells with each other. A pair of wells may contain a protein solution and a salt solution to start crystallization. A trio of wells may have biological cells that are moved first to expose them to a growth factor and then to a fixative.



This drawing depicts a cross-section of a set of DMDA specimen wells, one of which can include a reverse osmosis membrane to dewater a protein solution and thus cause crystallization. Depending on individual needs, two or three wells may be used, the membrane may be absent, or other proprietary enhancements may be present.

Upon deactivation, the blocks are moved to isolate the opposing wells from each other or (alternatively) to expose the wells to fixing or preserving agents. The design allows the screening of large numbers of specimens with slight variations in conditions so the optimum experiment design can be determined from the matrix. The DMDA has flown numerous times aboard suborbital rockets, the Space Shuttle, and other spacecraft since 1989.

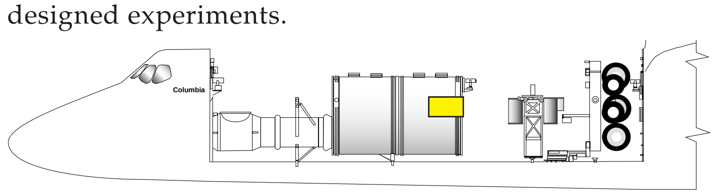
The LMA is a manually operated system. It holds larger fluid volumes per sample than the DMDA and is used to mix two or three liquids or biomaterials in microgravity at predetermined times. Each vial contains up to 5 ml of experiment materials in two or three chambers. These materials can be mixed in various proportions and at different rates. An LMA vial consists of a transparent Lexan syringe containing plungers and valves. The fluids, which may include solids in suspension, are in two or three compartments, depending on the experiment needs. Typically, four vials are in a lightweight tray inside a containment bag. Several trays are carried in a temperature-controlled locker. Upon activation, the astronaut pushes the plunger in a vial to move the liquid from one chamber into another. If 3-fluid vials are used, this procedure is repeated at a later point in the timeline to mix the third fluid (typically a fixative) in those vials.

Astronaut William G. Gregory activates LMA vials during STS–67. Other LMAs hang at top on the face of the middeck locker array.

Valerie Cassanto of ITA checks the Canadian Protein Crystallization Experiment (CAPE) carried by STS–86 to *Mir* in 1997. DMDA hardware to be flown on STS–107 is similar.

Previous Results

Because of the commercial nature of many of ITA's experiments, the results often are proprietary. However, an experiment from the STS–95 mission illustrates the results that ITA and its partners frequently achieve. The Bence Jones protein is associated with pain caused by bone cancer. An STS–95 experiment produced a large crystal that detailed the protein structure. This helped scientists identify the active site on the protein related to its painful disposition in the tissues of bone cancer patients. Scientists now can produce better crystals on Earth for mapping analysis and to find ways to block the active site that causes the excruciating pain of bone cancer. The large number of experiment samples ITA flight hardware can accommodate in the small volume of a Middeck Locker has enabled a wide variety of multidisciplinary commercial and scientific research, including hundreds of student designed experiments.



Approximate location of this payload aboard STS–107.