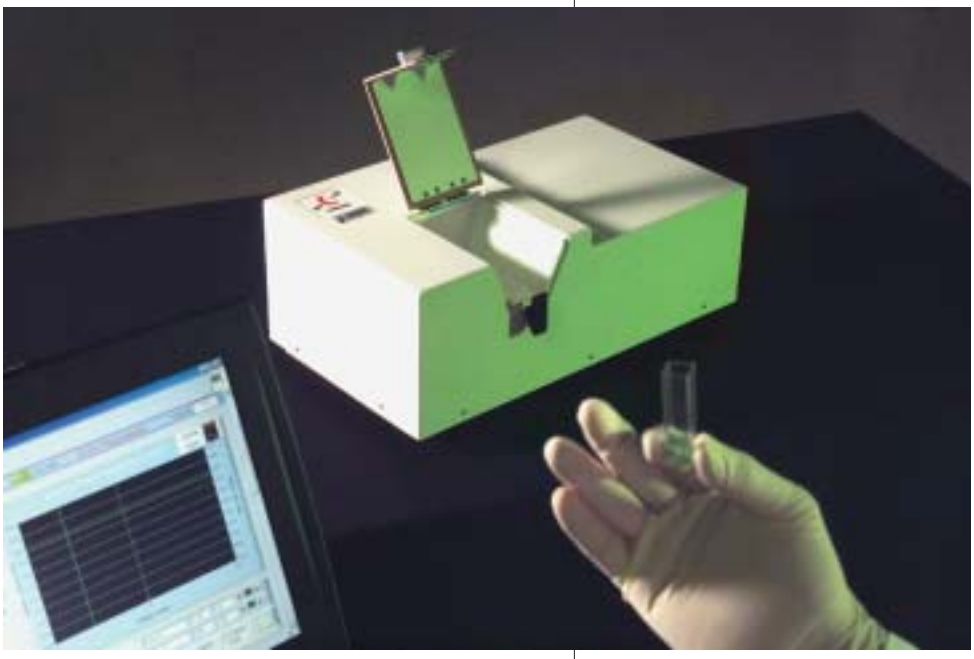
Illuminating Cell Biology

An instrument developed to help scientists study cell biology onboard the International Space Station (ISS) is also benefiting researchers here on Earth. The Cell Fluorescence Analysis System (CFAS), developed by Ciencia, Inc., of East Hartford, Connecticut, is a versatile, compact fluorometer designed to perform cellular functional assays and in vitro biochemical assays. The innovation will play an important role in studying biological specimens' long-term adaptation to microgravity.

With results from previous experimental studies showing that space flight has a significant impact on living cellular systems, NASA is preparing the Life Science Research Facility on the ISS to open a new era in gravitational biology. Researchers at the space-based laboratory will study cell development, signal transduction, cytoskeleton organization, gene expression, and many other cellular processes. To accomplish these goals, NASA recognized that fluorescence spectroscopy, one of the most powerful methods available for cell biology research, was a necessary technique within the facility, as well.

A major roadblock to incorporating this tool was the instrument's massive size prohibiting its deployment in the Space Station. With room requirements of 20-to-60 cubic feet and a weight of several hundred pounds, the typical fluorometer exceeded the available space to conduct experiments. Another problem was that the instrument's high power consumption might make it inoperable within the available power resources, and could cause power spikes leading to possible interferences in equipment operation.



The Cell Fluorescence Analysis System assists scientists conducting cell biology research on Earth and on the International Space Station.

To solve these problems, NASA's Ames Research Center awarded Ciencia a **Small Business Innovation Research (SBIR)** contract to develop a system that would address the size, mass, and power constraints of using fluorescence spectroscopy in the Life Science Research Facility. Ciencia, successful in creating the CFAS product to meet NASA's needs, recently delivered the product to Ames and is progressing with commercial sales. At Ames, researchers in the bone and signaling laboratories plan to use the CFAS to investigate the role of integrin and extracellular matrix protein interactions in the mechanotransduction of forces induced by hypergravity and hydrostatic pressure. "We are looking forward to using the CFAS to develop fluorescence resonance energy transfer and lifetime analysis assays for integrin clustering, an important step in cell adhesion and gravity mechanotransduction," stated Dr. Eduardo Almeida, research scientist in the Ames Gravitational Research Branch. "The CFAS represents an investment into future ISS analytical capabilities that should enable cutting-edge spaceflight cell biology consistent with NASA's vision to extend life into space," explained Donald Vandendriesche, ISS cell culture unit lead and contracting officer's technical representative for CFAS development.

Commercial applications for Ciencia's technology include diverse markets such as food safety, in situ environmental monitoring, online process analysis, genomics and DNA chips, and noninvasive diagnostics. Ciencia has a U.S. patent for its fluorescence lifetime sensing technology and has licensed the technology to HTS Biosystems, of Hopkinton, Massachusetts, for applications in high-throughput screening for drug discovery. Ciencia and HTS Biosystems are jointly developing commercial products based on the technology, including a fluorescence lifetime microwell plate reader.

Ciencia has already sold the system to the private sector for biosensor applications. Dr. Jerome Schultz, the director of the Center for Biotechnology and Bioengineering at the University of Pittsburgh, purchased Ciencia's fluorometer technology in the form of a minimally invasive fiber-optic glucose sensor. The center, which has approximately 100 researchers covering the fields of biosensors, molecular biology, gene therapy, and artificial organs, is using the system for clinical applications. ❖