Operational Accomplishments Report
ISS Flight 2A.2B (STS-106)

Commercial Generic Bioprocessing Apparatus (CGBA) Payload
BioServe Space Technologies
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I. Introduction

A. Hypothesis

The two experiments housed in the Commercial Generic Bioprocessing Apparatus (CGBA) during STS-106 were designed to explore how biological processes are affected by microgravity. The first was a developmental study into the effects of microgravity on motor-neuronal growth in the fruit fly species *Drosophila melanogaster* and the second study was designed to characterize changes in kidney cell gene expression.

B. Objectives of the Investigation

The objective of the primary experiment, called NIH-B1, was to determine how gravity affects neuronal development of the *D. melanogaster* embryo and larvae in microgravity, specifically observing the neural connections to muscle fibers. The PI is Dr. Haig Kesheshian of Yale University.

C. Previous Mission Experience

STS-106 was the first successful flight for the NIH-B1 experiment. (It had previously flown on STS-93, but the science objectives were not accomplished due to an electrical anomaly with the payload.) The renal cell experiment had previously flown on the STS 90/Neurolab. Beginning with STS-50 in 1992, the CGBA payload has now flown in various configurations a total of 12 times onboard the shuttle (including STS-106) and has also resided on Mir twice during long-duration missions of approximately 4 months each. For STS-106, the CGBA payload consisted of one Isothermal Containment Module, Version 3 (ICM v3). The ICM v3 is a middeck locker insert that provides processing and independent thermal control for 8 experimental sample containers, with ~1-liter of total volume in each, as shown with the lid open in Figure 1.

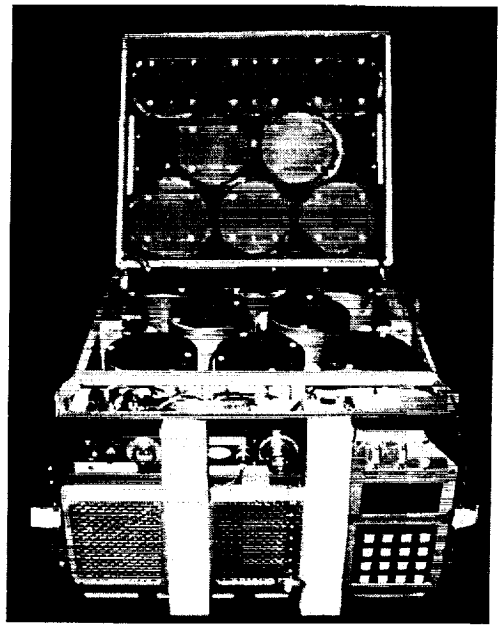

Figure 1. Commercial Generic Bioprocessing Apparatus (CGBA) Isothermal Containment Module version 3 (ICM v3).

II. Methods/Research Operations

A. Discussion of Method/Protocol

The CGBA payload was launched aboard STS-106 September 8, 2000 and returned on September 20 (MET = 11 days 19 hours 10 minutes). The primary payload operations were carried out autonomously, but the crew provided daily status reports for the CGBA and ensured that adequate flow into the air inlet was maintained. In addition, a request was made and successfully carried out to manually update the CGBA computer files with the new landing day and time when the decision was made to extend the mission. This task was performed per an existing alternate procedure called Update End of Mission . All payload operations were completed successfully and thermal control of the payload water cooling loop was maintained within the specified limits of 20.0 ± 2 deg C throughout the mission.

For the NIH-B1 experiment, seven Gas Exchange (GE) — Group Activation Packs (GAPs) shown in Figure 2 (left), were autonomously run through pre-programmed temperature profiles to control on orbit development times of fruit fly larvae. Each GE-GAP contained eight 100 mm Petri dishes, 7 of which housed the fruit fly larvae samples on agar, with one used to stow a temperature-recording device (Stowaway¤). All seven GE- GAPs were launched at 11.5 deg C and increased to approximately 18 deg C to initiate fruit fly development soon after reaching orbit. They were then sequentially decreased in temperature back to 11.5 deg C to arrest fruit fly development at different time points during the mission.

III. Results

A. Pre-flight, In-flight, Post-flight Anomalies

No pre-flight anomalies occurred. Two minor in-flight anomalies were experienced as described below, but all experiment activations and terminations occurred as planned. A computer glitch was observed during post-flight de-integration, but the incident was without operational impact.

In 2 of the 7 NIH-B1 experiment GAPs, temperatures recorded in-flight with sensors internal to the fruit fly culture dishes were observed to have drifted upwards towards the end of the mission by as much as 1.5 deg C above the planned set point. The end plate temperatures were maintained ± 0.05 deg C; however, in the central portion of the GAP furthest away from the controlled end plate, the temperatures were found to be higher than the set point over time as a result of the increasing gradient requirements necessary for the heat pump to function at the lower set temperatures. As more GAPs were cooled, more heat had to be pumped from the locker, which consequentially drove increasing thermal gradients from the sample cores to the endplates. These temperature drifts were not expected to significantly impact the developmental rate of the fruit flies; however, ground controls are being run to duplicate the actual flight temperature profiles and allow accurate comparison of the flight and ground samples.

A problem was detected during post-flight payload de-integration on the runway, which prevented the computer from properly shutting down and displaying an OK to power down message. This anomaly did not affect science results or compromise payload performance. The anomaly was traced to an error on a secondary hard disk. As a result, the payload was simply shut down manually by pulling the circuit breaker to continue the removal process. In the subsequent reboot, the computer was able to work around the hard disk error and the function nominally. Four separate incidents were later found to have occurred on the secondary drive throughout the mission at different times. The anomaly is still under investigation with speculated causes ranging from EMI or radiation to mechanical failure. No impact to in-flight data collection or operations occurred.

B. Completeness/ Quality of Data

The CGBA facility operated successfully throughout the STS-106 mission. With a built-in accelerometer system, the payload detected launch and controlled the experiments on schedule. Both experiments appear to have functioned appropriately and collected the required data. Scientific data are still being analyzed, but the preliminary results thus far reported look positive. Both science teams view the mission as a success in terms of payload operation and data collection. Further detailed analysis of payload anomalies and research results are underway.