Bacteriophage-based bioluminescent bioreporters are currently being developed for the detection and identification of bacterial pathogens within the spacecraft environment. Microbes in enclosed environments pose serious threats; with the recent mandate for the United States to establish a lunar base within the next 10 years and reach Mars by 2025, the need arises for early and rapid detection of bacterial pathogens that may compromise astronauts’ immune systems, contaminate food and water supplies, and degrade system materials. Bioluminescent bioreporters are whole-cell biosensors that produce light in response to specific chemical agents via transcriptional activation of lux/reporter gene fusions. Bacteriophage-based bioreporters utilize the pathogen-specific phage infection as a means of inducing bioluminescence through a modified quorum sensing signal. \(luxI\) is genomically inserted into the phage, resulting in the production of acyl-homoserine lactone (AHL) autoinducer molecules upon host infection. In the proposed overall bioreporter system, the AHL molecule will diffuse into co-located bioreporter cells containing the \(luxCDABE+luxR\) operon; these cells produce measurable light in response to the infection. Bioreporter systems are currently being developed for the detection of Salmonella, Escherichia coli, Staphylococcus aureus, and Pseudomonas aeruginosa. Preliminary data have been collected from the Salmonella and E. coli systems. In both, a constitutive promoter was fused to \(luxI\) and incubated with bioreporter cells, producing bioluminescence at 8,000 and 14,000 counts per second, respectively. These bioreporter systems are to be coupled with an integrated circuit optical transducer, the end product being a sensitive, low-cost biochip capable of real-time, on-line monitoring of microbial contamination within the spacecraft environment.