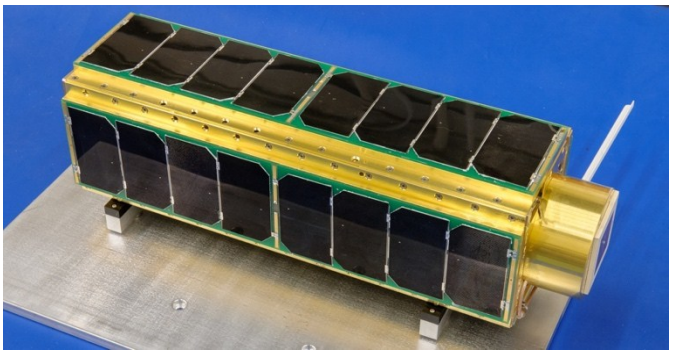
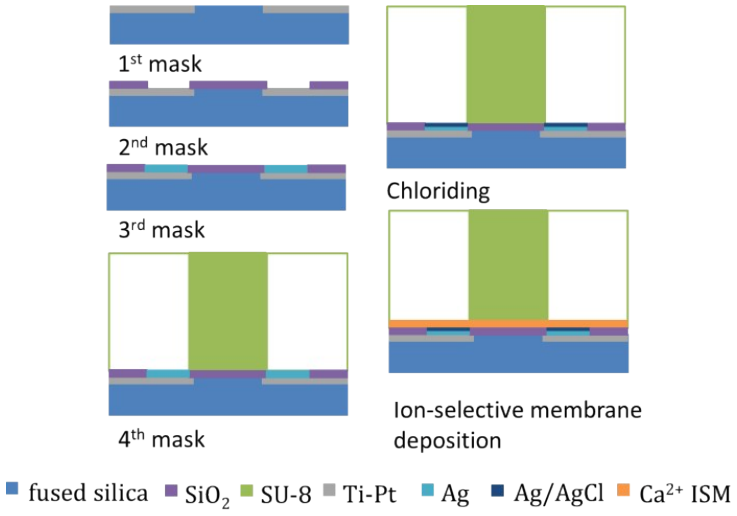
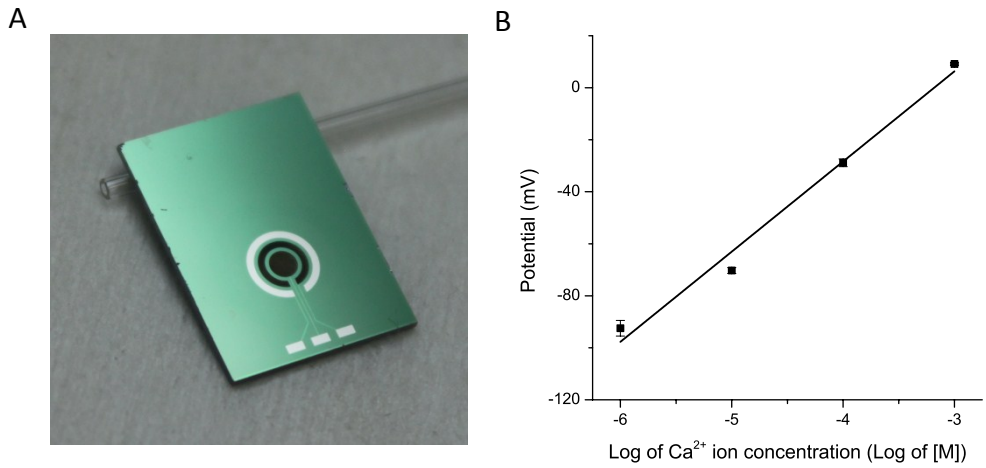
Electronic Supplementary Material (ESI) for Lab on a Chip.



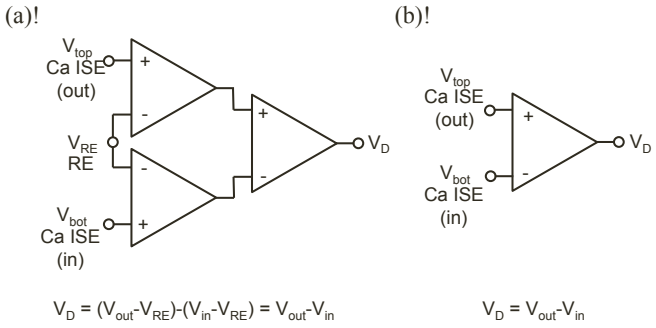
Supplemental Figure 1. The fully assembled SporeSat nanosatellite is a 34 cm x 10 cm x 10 cm rectangular cuboid. The lab on a chip payload comprises two-thirds of the internal spacecraft volume. The nanosatellite accommodates a total of 96 spores on three bioCDs, two of which rotate to provide artificial gravitation from 0.06 to 2.0 x*g* while in orbit. The third bioCD provides a stationary microgravity control. The satellite payload integrates motors, thermal control, measurement electronics, and sensors with the three bioCDs, all housed in a container with an internal pressure of 1 atm. The ground experiments presented here utilize these same hardware components, allowing for an autonomous programmable experiment.



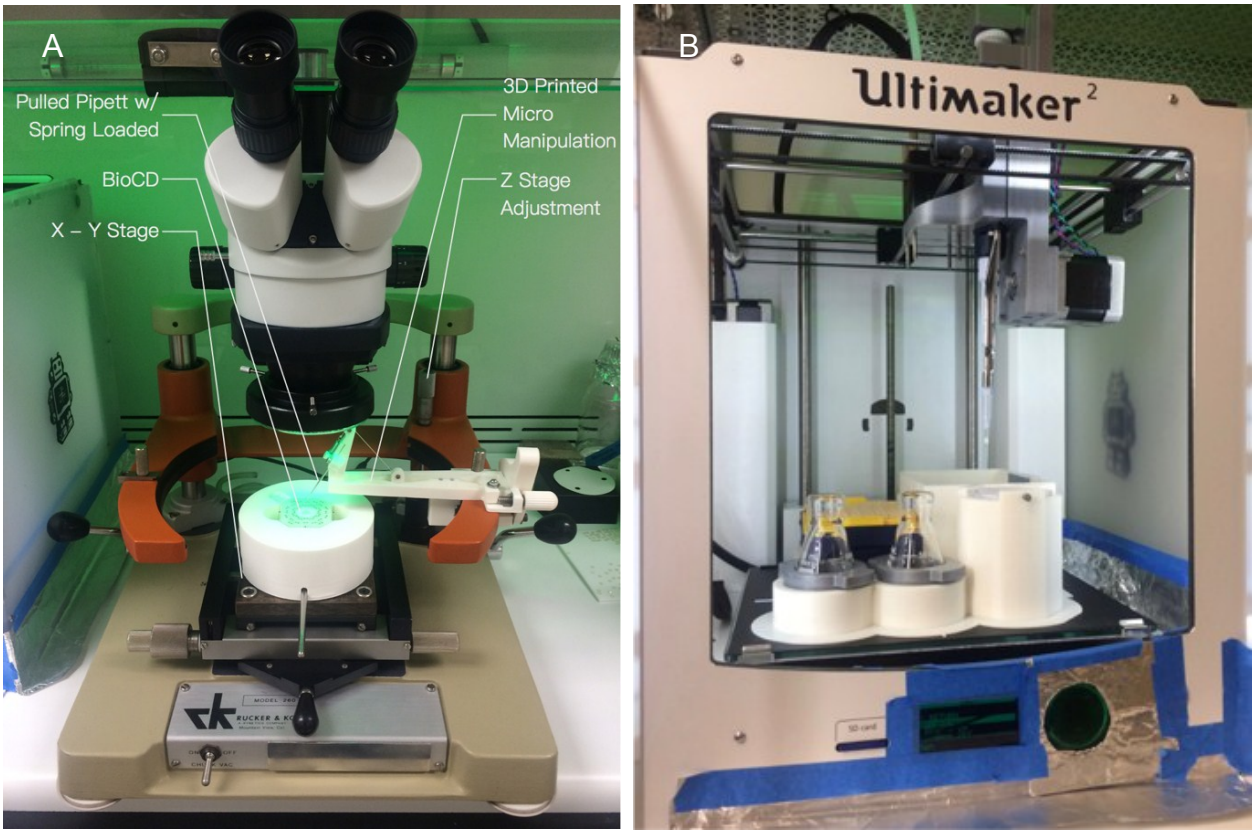
Supplemental Figure 2. Summary of four mask bioCD fabrication process. Ti-Pt is first patterned to form the electrode connections and contact pads followed by a SiO2 passivation layer to leave only the electrodes and contact exposed. Silver is then deposited on the electrodes followed by formation of the SU8 spore wells. Finally, the Ag is chlorided to form Ag/AgCl and then the calcium selective ISM is deposited.



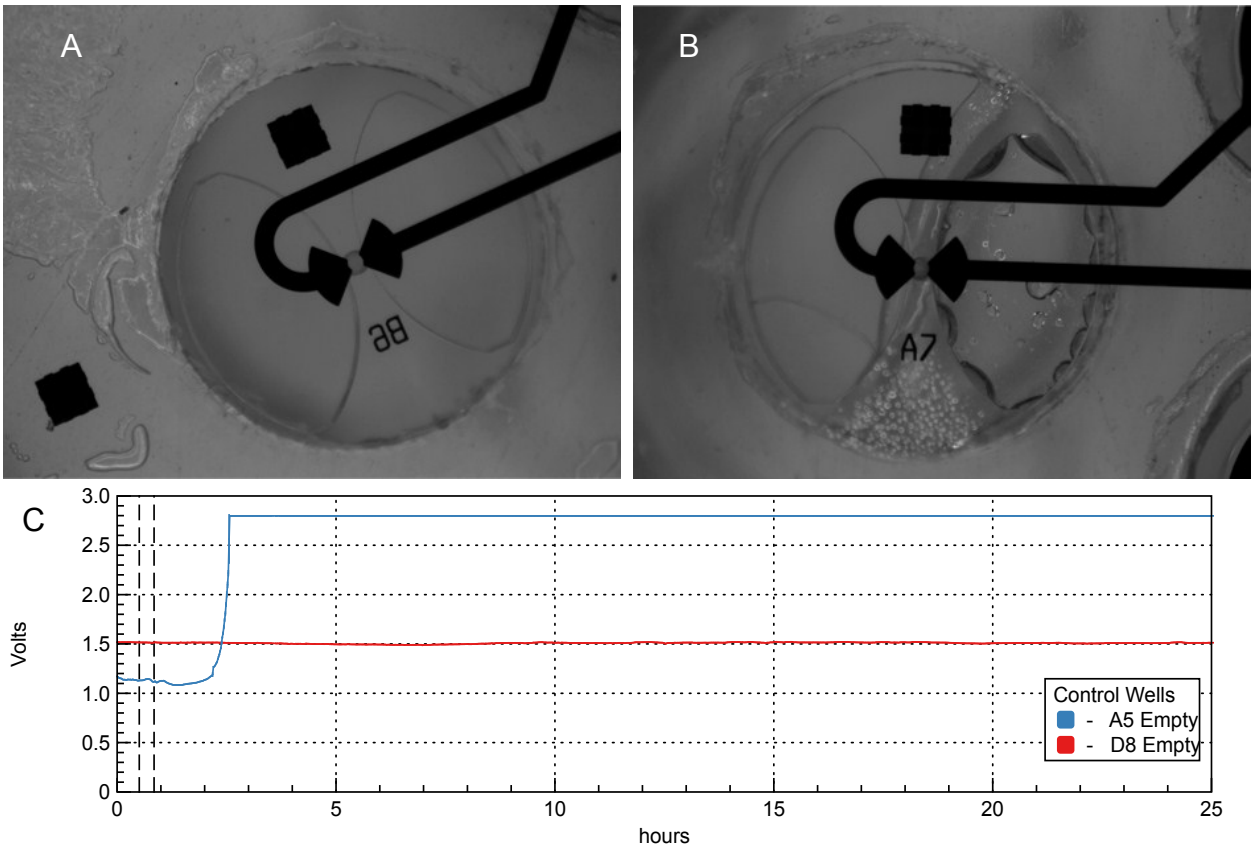
Supplemental Figure 3. a) Three electrode chip for calcium ISM testing and calibration consisting of an Inner working electrode surrounded by outer reference and counter electrodes. b) Calibration curve of calcium selective membrane. Slope = 35 mV / decade.



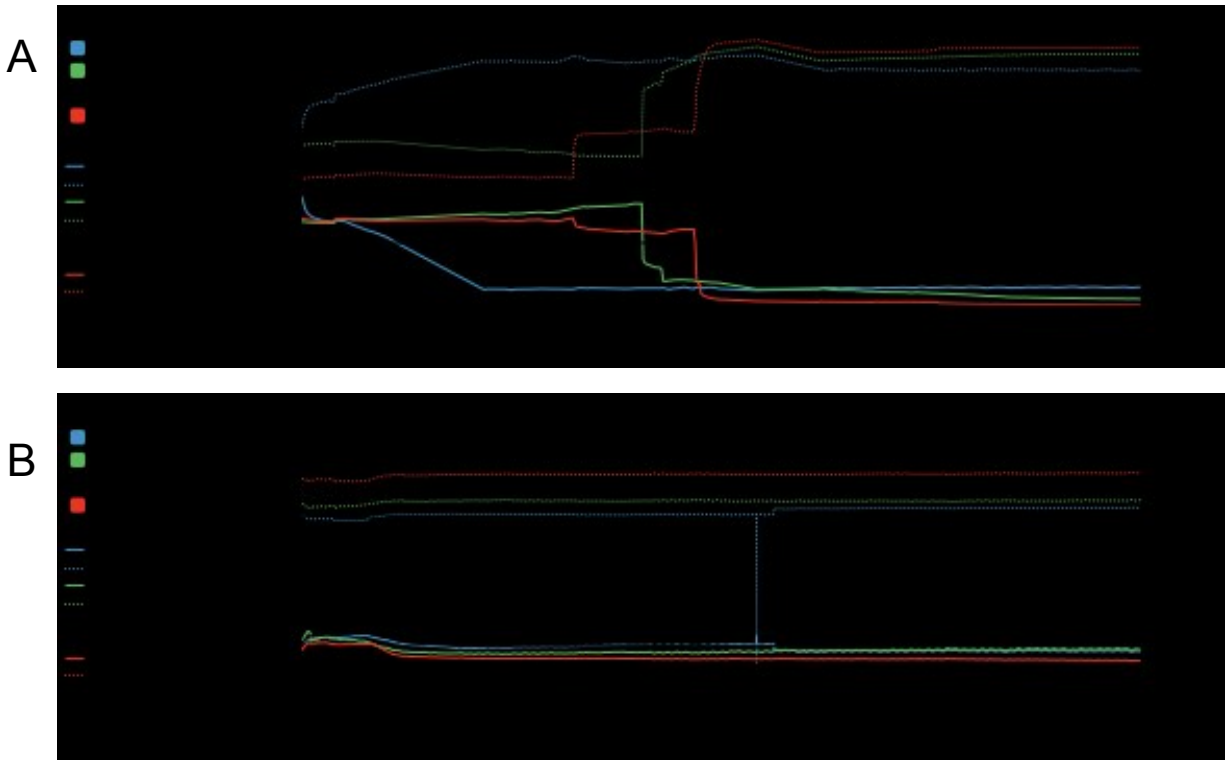
Supplemental Figure 4. On the bioCD, calcium electrode pairs were configured for differential measurement. a) In the traditional set up, each ISE voltage is measured relative to a reference electrode. b) In a differential measurement, the electrode voltages are measured relative to each other, thus eliminating the reference.



Supplemental Figure 5. A. Image of converted Probe Station for Spore Loading. The probe station greatly enhanced the precision and repeatability of placing the spore into its location between the SU8 "pincers" on the bioCD. This station also allowed us to observe loading at magnification so that visible observations of minor damages of the spore is possible. The probe station was fitted with custom designed and 3D printed components to hold the bioCD in place and an arm equipped with a pulled capillary tube and plunger system to manipulate the spore. The pulled capillary is used to dispense sterile DI water into the location were the spore will be placed. The surface tension of the DI water in the pulled capillary is used to hold the spore, then the spore is placed into its location on the bioCD with a small (~0.2µL)The DI water evaporates off and leaves the spore behind and in position. The well is now ready for agar media loading. **B.** Agar media loading with converted 3D Printer. The X and Y stage of a consumer 3D FFD printer was fitted with a custom designed 3D printed component that held a pipette and a rack-and-pinion system to depress the pipette. Actuation of the rack-and-pinion system was accomplished by a stepper motor that was repurposed from its original function as the filament extruder for the printer. The printers heated bed was used to keep the agar at 50°C. After all well ISMs are covered with ~0.2µL of agar media, the machine is used to load ~15µL of warm agar on top of the lower layer and fill the wells without bubbles.



Supplemental Figure 6. A. Image of a properly loaded spore. No bubbles in agar indicating good ionic and electrical contact with agar media and ISM. **B.** Image of a poorly loaded spore. Notice bubbles on right indicating that the ISM is not in ionic or electric contact with agar media. **C.** Plot of voltage (1.5V offset, gain = 5) comparing a properly loaded control (agar only) well with expected stable differential (red) vs. a plot of a poorly loaded control (agar only) well with widely drifting differential which ultimately rails, indicating an open circuit (blue).



Supplemental Figure 7 A. Impedance of wells as they were allowed to dry-out test. This test was conducted to establish the characteristic impedance signal as the agar dried in the bioCD wells. Notice the characteristic sharp changes in impedance. **B.** Plot of stable impedance signals in a sealed bioCD over a 90 period. These results indicate that the agar media has not dried out.

Supplemental Figure 8. The final assembled ground unit consists of a sealed black anodized aluminum block that contains the completed bioCD assembly with light and PCB amp board. The master PCB stationary heating element are located exterior to the sealed unit.

Supplementary Table 1. Results from each ring, where β_0 is the intercept, β_1 is the regression coefficient for germination time, and β_2 is the regression coefficient for spore type.

Ring	Parameter	Estimated β	Standard error	T statistic	P value
A	β_0	1.30	0.056	23.1	0
	β_1	-0.25	0.006	-41.0	0
	β_2	**-2.66**	**0.055**	**-48.4**	**0**
B	β_0	0.29	0.024	11.7	0
	β_1	-0.09	0.003	-30.4	0
	β_2	**-0.14**	**0.027**	**-5.2**	$2 * 10^{-7}$
C	β_0	-0.47	0.052	-29.3	0
	β_1	0.01	0.003	3.2	$1.35 * 10^{-3}$
	β_2	**1.37**	**0.047**	**29.3**	**0**
D	β_0	-0.47	0.050	-9.5	0
	β_1	-0.08	0.004	-17.4	0
	β_2	**-0.17**	**0.072**	**-2.3**	$2 * 10^{-2}$

Note: In the P value column of Table 2, "0" means the corresponding p value is very small and very close to 0.

Supplementary Table 2. Results from pooled analyses, where β_0 is the intercept, β_1 is the regression coefficient for germination time, and β_2 is the regression coefficient for gravity.

Ring	Parameter	Estimated β	Standard error	T statistic	P value
Live spore	β_0	4.31	0.113	38.0	0
	β_1	-0.14	0.002	-56.5	0
	β_2	**-2.91**	**0.073**	**-40.0**	**0**
Negative control	β_0	-2.16	0.129	-16.7	0
	β_1	-0.07	0.002	-33.0	0
	β_2	**1.326**	**0.079**	**16.7**	**0**

Supplementary Table 3. Composition of Germination Media

Component	Final Concentration
MS media micronutrient (Sigma, M0529)	0.5x
$CaCl_2$	0.1 µM
NH_4NO_3	10.31 mM
$MgSO_4$	0.75 mM
KH_2PO_4	0.625 mM
KNO_3	9.4 mM