SAMMI: Smart Autonomous Mercury Monitoring Instrument

Jakhete, Rohan (School: South Fork High School)

Water pollution has quickly become the deadliest global issue of the century, leading to 1 billion sicknesses every year. A lack of awareness of the quality of water sources means that vulnerable populations are at risk of developing serious health complications. Water quality data is heavily centralized and often, nonexistent around the world. To tackle these global water challenges, we must consider policymaking in three aspects: (1) Empowering decision making for communities, (2) Decentralizing information availability, and (3) Making information available with low investment costs. In order to meet these guiding principles, I tested, designed, and built SAMMI: a low-cost, 3-D printed buoy that is able to monitor ionic mercury in real time for extended periods. Square wave anodic stripping voltammetry was used to obtain a limit of detection (LOD) of 10.8 parts per billion (ppb), with minimal interference from cations such as Ag^{1+}, Ca^{2+}, and Fe^{3+}. The response time of the quantitative voltammogram was approximately 45 seconds whereas the rapid-scan qualitative technique was less than 5 seconds, which facilitates future applications for rapid profiling. 3D-printed PLA shells were fabricated to develop the structure of a buoy. Electrochemical sensing of Hg^{2+} was integrated into a sediment trap and pump in a 3D-printed buoy. In this future vision, qualitative rapid-scan sensors provide classification and heuristic functions to guide the targeted application of high-quality analytical tools that produce quantitative data. Not only is SAMMI more affordable and sustainable compared to current water quality data solutions, SAMMI provides easy-to-understand data analytics for everyone.