

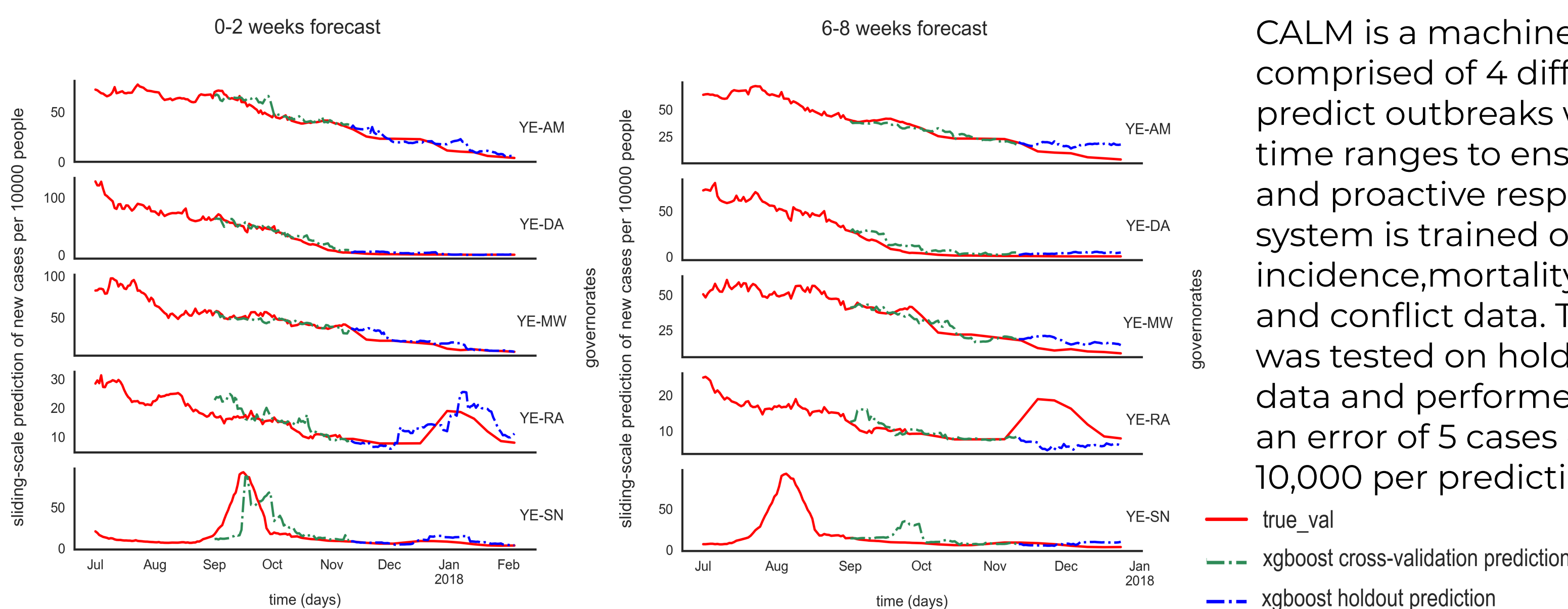


Capture the Data | Activate the Response

CAPTIVATE

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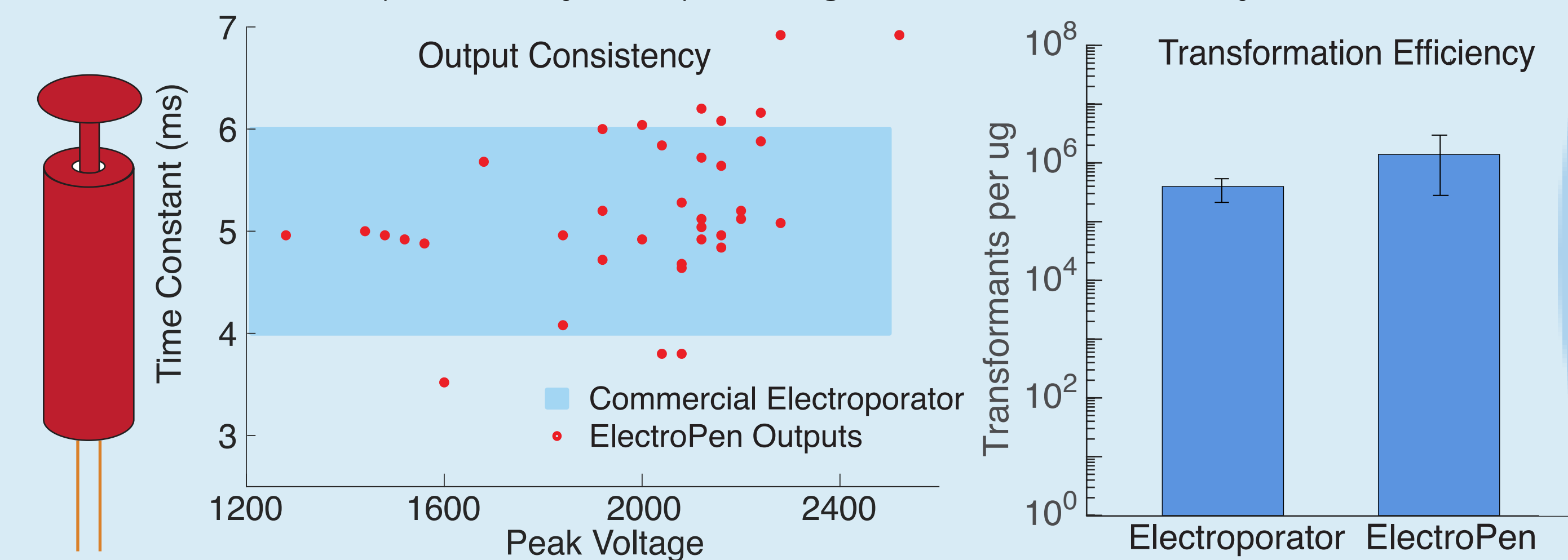
Prediction: Cholera Artificial Learning Model



CALM is a machine learning system comprised of 4 different models that predict outbreaks with varying time ranges to ensure optimized and proactive responses. The system is trained on Cholera incidence, mortality, rainfall, and conflict data. The system was tested on hold-out set data and performed with an error of 5 cases out of 10,000 per prediction.

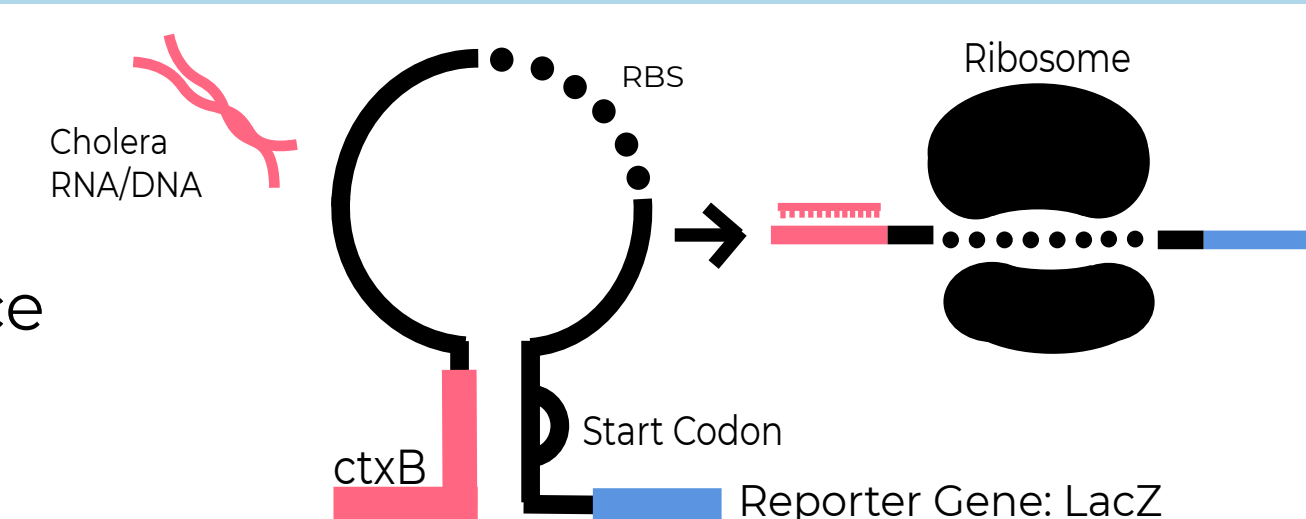
Electroporation: ElectroPen

The ElectroPen (*patent pending*) is a 20-cent, portable electroporator, that extends functionality beyond research laboratories to settings where access has traditionally been limited. Two additional iGEM teams have verified that the ElectroPen matches transformation efficiencies of commercial electroporators without requiring electricity and at a substantially decreased size and price. The ElectroPen voltages fall within the range of commercial electroporators and has tremendous reproducibility in output voltages confirmed theoretically.



Detection: Cholera Toehold Switch

The gene of interest, ctxB [Cholera enterotoxin subunit B], is nontoxic on its own, but is specific to the pathogenic strain of Cholera. We designed our toehold switches to detect ctxB and to produce blue expression in response to LacZ.

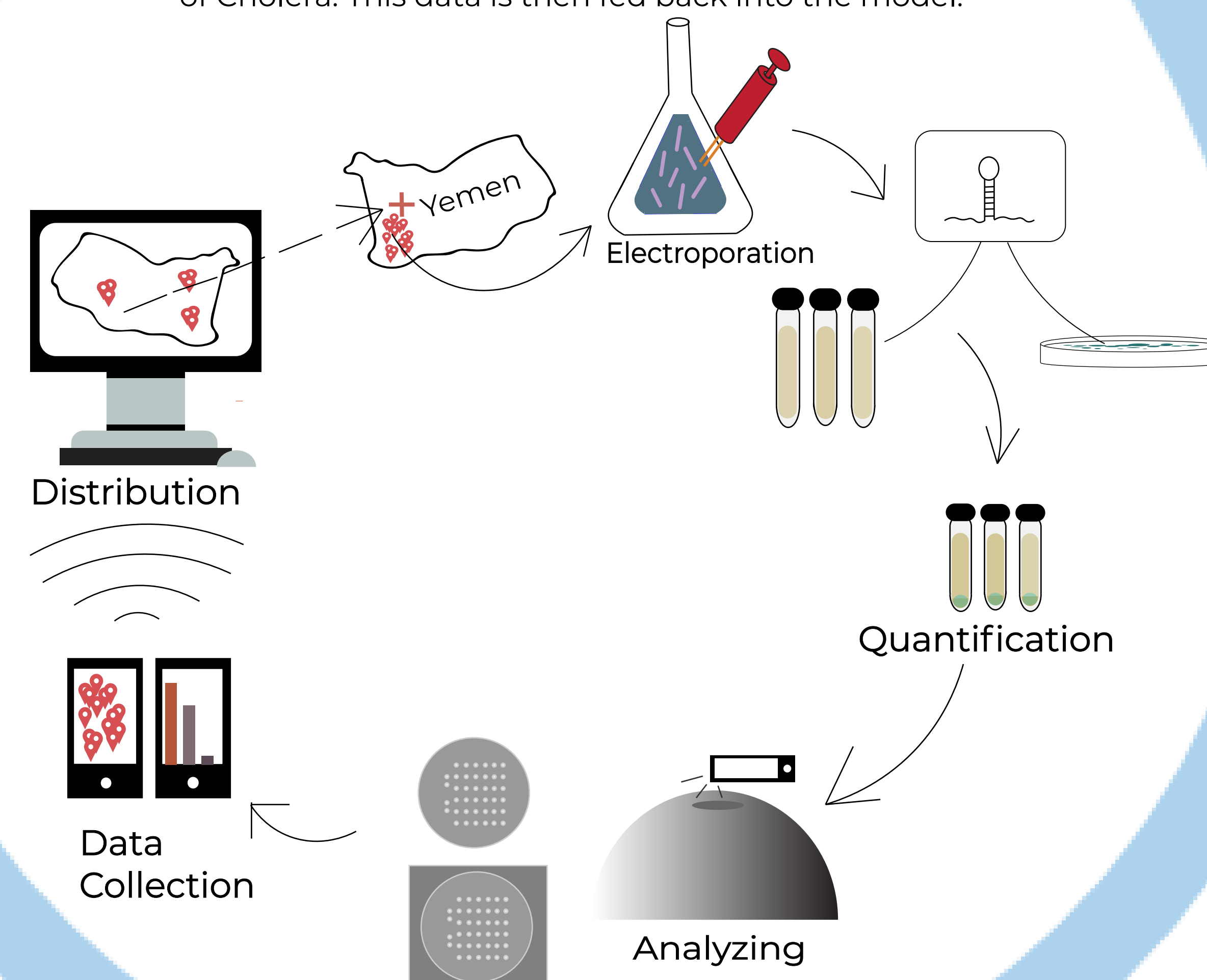


(Top plates) The transformation of toehold switches presents leakiness due to the strong T7 promoter. Dual plasmid transformations (bottom plates) expressed lower blue expression in comparison to the single switch transformation.

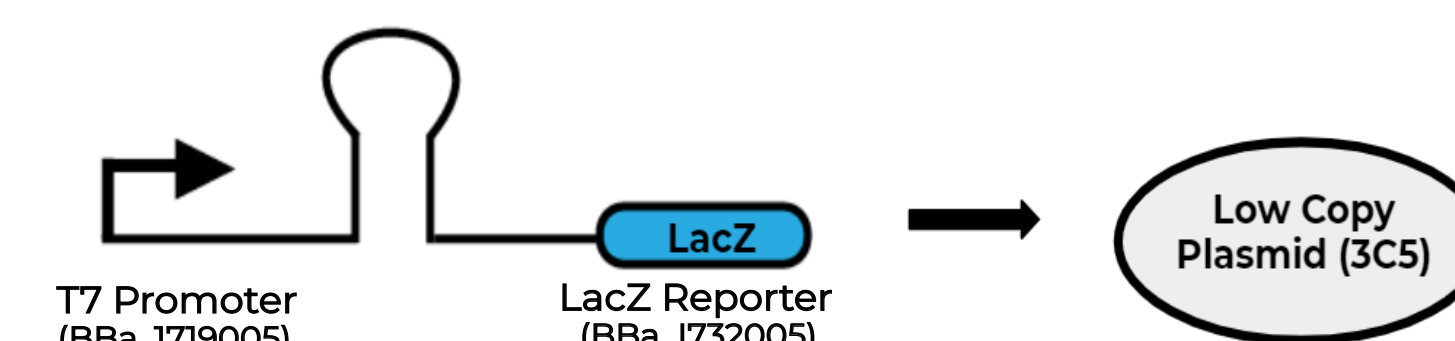
Sequencing results show the Cholera switches did not contain the correct sequences because of the misalignment of the Gibson primers.

Problem Statement

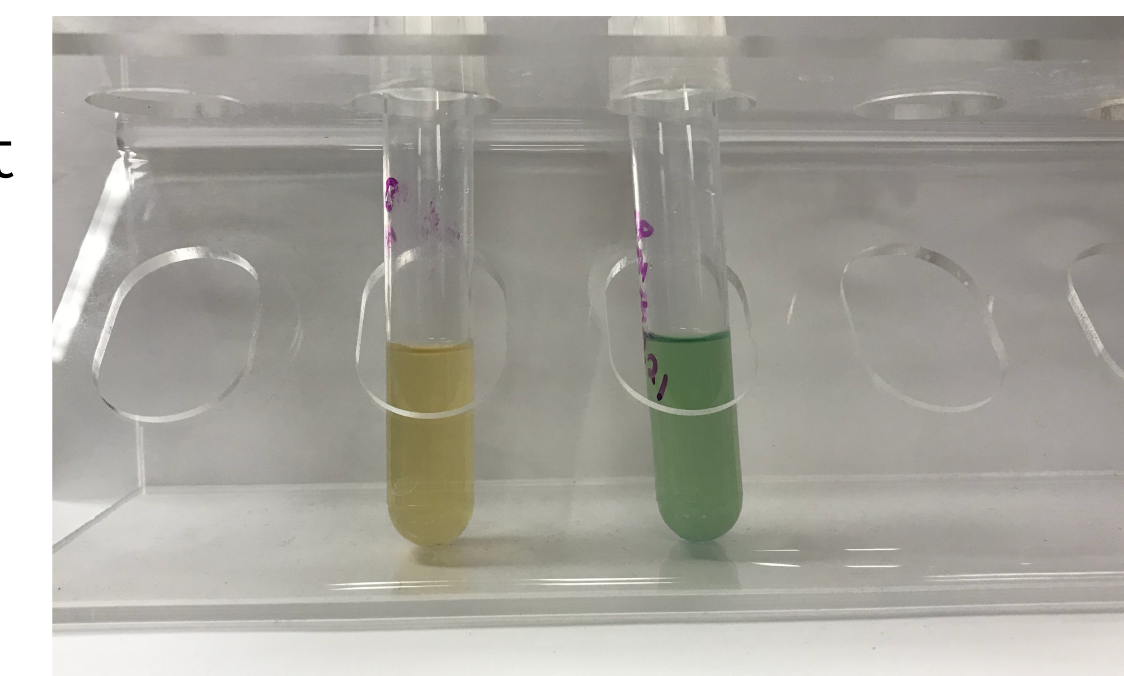
Contaminated water is the leading cause of waterborne diseases such as pathogenic Cholera. Individuals who lack access to clean water are forced to utilize contaminated water sources, resulting in infections and fatalities. CAPTIVATE addresses these issues with CALM, a predictive machine learning model that provides advanced notice of potential outbreaks to health aid organizations, allowing for the distribution of portable, low-cost water sample kits to identify and analyze water samples for presence of Cholera. This data is then fed back into the model.



Quantification: Proof of Concept



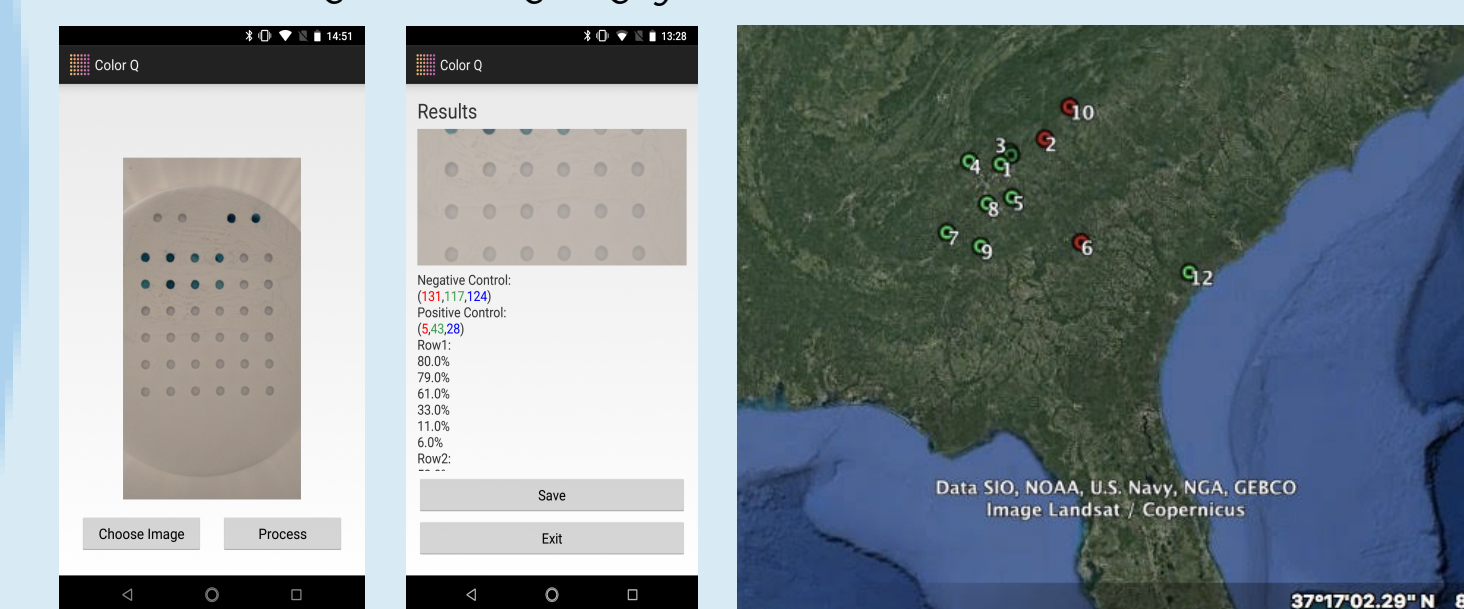
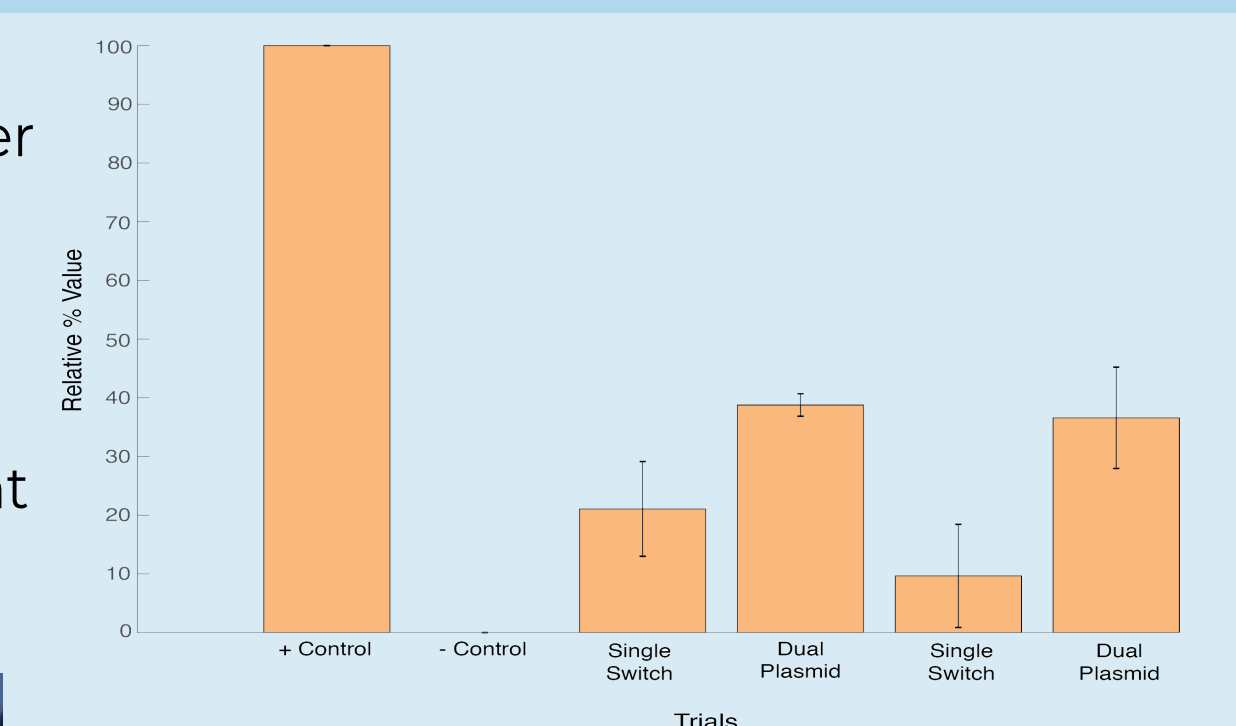
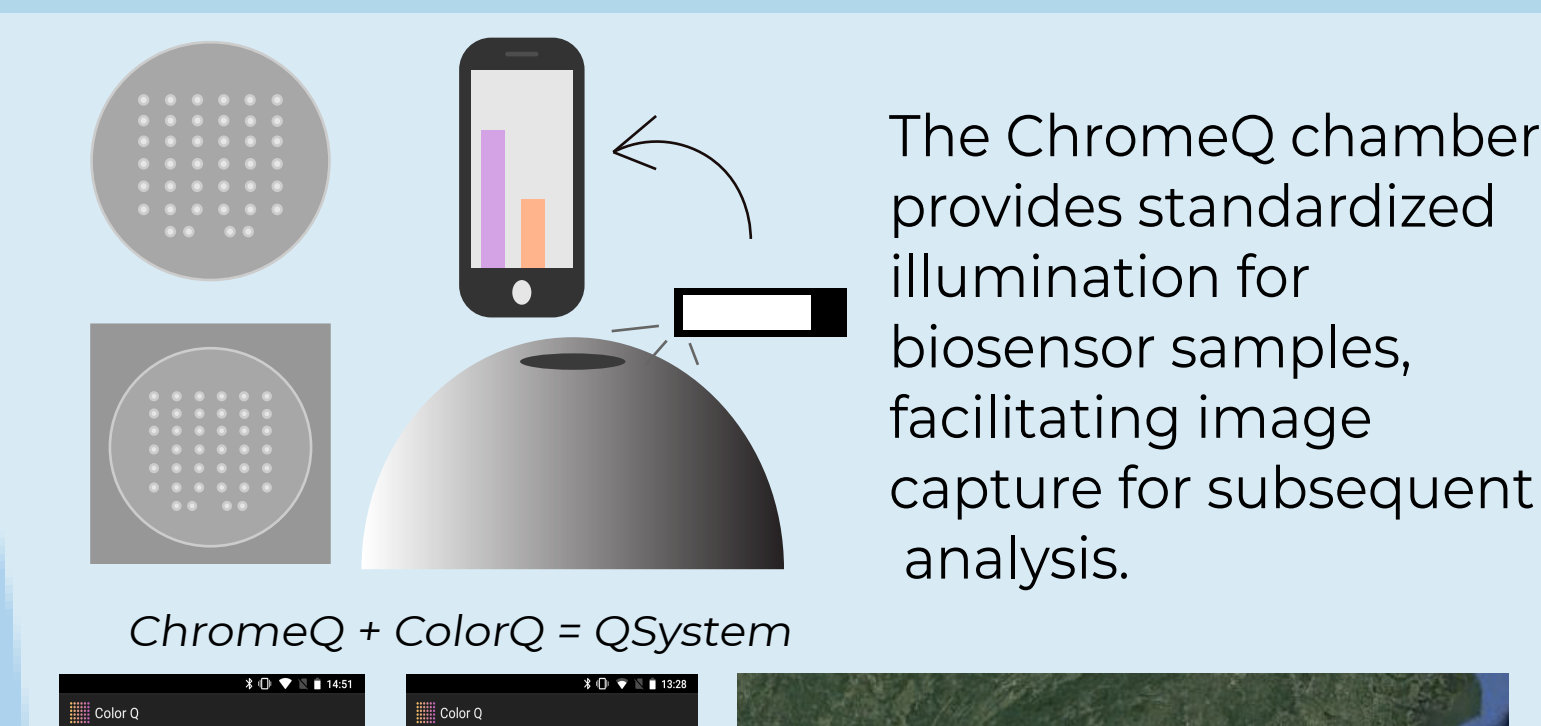
T7 LacZ Toehold Switch, a construct that can be applied as a biosensor, consists of a T7 promoter and a LacZ reporter gene. In the presence of its matching trigger, the construct expresses the blue pigment in LacZ.



LacZ expression in negative control versus experimental

(Left tube) The single switch transformation validates that without the trigger present, there is no blue expression demonstrating the inhibition of LacZ. (Right tube) The successful dual plasmid transformation presents the blue expression of LacZ from the T7 LacZ Toehold Switch in the presence of its matching trigger.

Analysis: QSystem



The ColorQ app analyzes the captured image. Utilizing the RGB color model, the app characterizes expression in reference to a control. The corresponding values are saved and uploaded to a MySQL database with an added feature of location data, allowing for tracking of the spread of Cholera cases over time.

Distribution: Human Practices

Thirst Project

Lambert iGEM spoke to Evan Wesley about the Thirst Project's plans for the future, including our plan to distribute portable kits to nonprofits working in targeted areas. He confirmed the usefulness of the distribution kits and the CALM model, stating that data is critical for alleviating the water crisis.

Forecast Model

Dr. Mintz, a public health water expert from the Centers for Disease Control and Prevention (CDC), informed the team that in order to be efficacious, healthcare agencies need at least four to eight weeks notice of an outbreak to prepare an adequate response.

Science Education

To address demographic disparities in the scientific community, Lambert iGEM created a doll kit with basic laboratory materials designed specifically for elementary-aged girls to increase their exposure and interest in biotechnology. In addition, the team held a summer camp and created a camp guide to serve as a template for other iGEM teams. The impact from these events informed the decision to create a water discovery science kit to give back to the community members of Hato Mayor in 2019, allowing them to be stewards of their own water.

Dominican Republic

Several Lambert iGEM alumni and current members traveled to the city of Hato Mayor in the DR to work on a water filtration project. We met with Dr. Rainyer from the Ministry of Health in the DR, who emphasized the lack of practical mechanisms available to detect waterborne diseases.

Biosecurity

Using guidelines from the CDC, we developed protocols for the reuse of the Spira swab, the disposal of the used biosensor cells, and the disinfection of the QSystem.

Achievements

Georgia State Capitol

Georgia State District 25 Representative Todd Jones recognized Lambert iGEM at the Georgia State Capitol.

Dominican Republic

Several Lambert iGEM members traveled to the city of Hato Mayor in the Dominican Republic to work on the installation of water filtration systems.

Submitted: Complimentary Trigger and Switch with T7 promoter (BBa_K2550000, BBa_K2550001)

LacZ Reporter Gene (BBa_K2550201), Stem-Loop Domain for Toehold Switch Design (BBa_K2550202), Ribosomal Binding Site for the Toehold Sequences (BBa_K2550200)

Designed: The ElectroPen (*patent pending*), Cholera Artificial Learning Model (CALM)

Improved: QSystem

Integrated: Dominican Republic Service Learning, Boehringer Ingelheim Feedback, Thirst Project, Day One Challenge, Collaborations with iGEM teams

InterLab at UGA

Lambert iGEM worked with the University of Georgia iGEM team to conduct InterLab experiments and compare results.

Cholera Detection Kit

Lambert iGEM created a kit that contains materials necessary for Cholera detection and analysis.