Extraction: Filter & Bead Homogenizer

**MICROMESH - Filter**
Our 2-dollar, multi-mesh, modular helminth egg filter for feces and soil samples isolates helminth eggs from other particles.

**OPENCELL - Homogenizer System**
Our low-cost system uses epicyclic gearing to shear the rigid chitin layer within the helminth egg and produces usable DNA within minutes. OpenCell transforms into a centrifuge and vortexer.

Proof of Concept: C. Elegans Toehold

**Purpose**
We used C. elegans as a model organism and NUPACK software to design a toehold specific to the lin-4 gene pre-mRNA primary transcript, F59G1.6. The toehold is assembled in pSB3C5 and the trigger in pSB1A3.

When the switch is in the presence of the trigger, the toehold will unbind, exposing the RBS and allowing for downstream expression of the GFP reporter.

Problem Statement

Current helminth diagnostic methods are time-consuming and expensive, leading infected individuals to go undiagnosed or utilize nonspecific anthelmintics. The world’s most neglected tropical disease, helminthiasis, is a result of this breakdown in infrastructure. Our frugal, point-of-care biosensor detects helminths from stool samples to provide a rapid, helminth species-specific diagnosis for infected patients.

Modeling: Tuning

**Purpose**
In the presence of a trigger RNA sequence, the toehold will unbind, allowing for translation of the reporter. A “leaky” promoter thus induces the reporter gene in the absence of the trigger and produces false positives.

**Improvement**
In our 2018 project, the J23106 promoter caused “leakiness” in our T7 toehold biosensor. LABYRINTH replaces its promoter with the weaker J23106 of the same Anderson series, thus, preventing leaky expression.

Modeling (Tuning)

An ordinary differential equation model simulates the reactions taking place during the cleavage of ONPG and a multivariate regression model correlates the strength of the promoter and RBS to expression. Experimental fluorescence data was taken to characterize strength of expression within the 2018 and 2019 toehold systems.

Quantification: Fluorocents

**Purpose**
Our low-cost fluorometer consists of a hardware case to hold the sample. The sample is attached to the ambient light sensor on Android phones. The device utilizes two filters positioned perpendicularly for calibration, similar to a typical fluorometer.

**Advantages**
The FluoroCents android app measures the lux value from a sample to determine the concentration of helminth egg DNA. FluoroCents costs less than $2 to create and does not require constant electricity.

Human Practices

**Dominican Republic**
Dr. Martinez emphasized the need for frugal diagnostics and inspired us to focus on soil-transmitted helminths.

**Georgia Tech**
We created the Zin-Q Android app as a companion to their zinc biosensor. Our toehold switch and hardware devices were designed and optimized in their labs.

**Thirst Project**
The Thirst Project helped maximize the impact of our marketing campaigns through social media.

**Boehringer Ingelheim**
Experts from Boehringer Ingelheim provided feedback on the feasibility and development for LABYRINTH.

Acknowledgements

Characterized: BBa_J10050-58, BBa_J23115, BBa_J0035, BBa_K2550001, BBa_K2550000

Validated: BBa_K2974101, BBa_K2974316, BBa_K2974400, BBa_K2974310, BBa_K2974410, BBa_K2974700

Achievements

**Flat C. elegans DNA**

**Fluorocents lux values of C. elegans Toehold Switch**

**3D graph of GFP expression as a function of promoter and RBS strength**

**BBa_J23106 Promoter**

**Zinc biosensor**

**Toehold switch assembly**

**Helminth Diagnostic Mapping Tool**

**HUMAN PRACTICES**

**INTEGRATION**

**EXTRACT**

**EXTRATION: FILTER & BEAD HOMOGENIZER**

LABYRINTH
Lambert iGEM