

Testing Self-Heating Components for Building Inexpensive *E. coli* Incubators

Methods

- Tests revolve around varying the type and number of heating components (primarily hand warmers and reptile shipping warmers) and modifying number of envelopes
- Temperature vs. time data is collected for all tests over a 24-hour modelled incubation period
- 110 mL water in Ziploc bag to emulate *E. coli* bag test
- Temperature data collected using Govee Wi-Fi Thermo Hygrometer
- Standardized shake time of heaters of 1 minute
- Modifications of envelopes include sealed, completely open, and 2 central venting holes

Background

- *E. coli* serves as an indicator bacteria to fecal contamination in drinking water
- While *E. coli* test kits remain inexpensive and available by request, incubation stays cost-prohibitive
- *E. coli* incubation lasts 24 hours and needs to stay in the 30°C to 44.5°C temperature range.
- This research is built off Zachary Mangel's project on designing a larger-scale incubator for school and community use

Date	Test Number	Heating Component Used	Number of Heating Components	Envelope Modifications	Sensor Used	Time in Range (min)	Time in Range (hour)	Time to Reach Range (min)
29-Mar	2	Hand warmers	8	Left open	2	1377	22.95	64
29-Mar	4	Reptile shipping warmers	8	Left open	4	1382	23.0	59
4-Apr	2	Hand warmers	8	left open	2	1361	22.7	72
11-Apr	1	Hand warmers	5	4 envelopes used, left open	1	1152	19.2	46

Results

- Tests with envelopes left completely open were most successful in reaching and maintaining the optimum range
- Likely due to the need for oxygen in the iron filament inside the warmers for heat-production reaction
- Mitigating heat loss has been successful by stacking envelopes inside of each other, but this has resulted in surpassing of the temperature range for a prolonged period of time
- Increasing the number of warmers has also yielded increased maintenance within the temperature range
- Future plans involve mathematically modelling heat loss and heat production of each self-heating component tested

