DREXEL UNIVERSITY School of Biomedical Engineering, Science and Health Systems

An Optogenetics Device for Engineering Neural Circuits in Drosophila

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What is Optogenetics?

Optogenetics is a new method for stimulating specific neural circuits using visible light

Why is it difficult to run fruit fly experiments with optogenetics with the current technology?

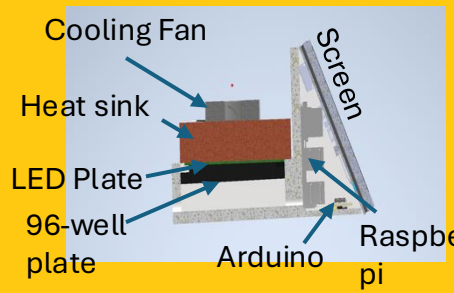
- Samples are individually stimulated, usually by hand in some sort of fashion.
- Causes inconsistencies during experiments
- Many prototypes have surfaced attempting to solve this problem; however, many ignore some factors while overcomplicating others

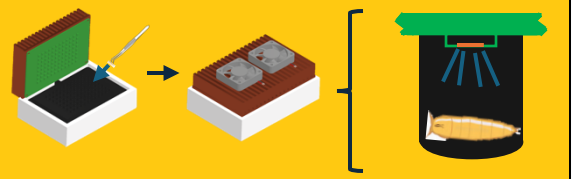
Why is optogenetic, fruit fly research relevant?

Many of the biological functions of fruit flies (*Drosophila*) are extremely similar to those within humans. If we can test basic biology theories within this model organism, we can generate a better understanding of neurological disease in humans.

DESIGN

Our design consists of a 3D printed body and a lights-on-top design, with the LED providing the stimulus being on top of each sample well. A simplified version is shown on the lower right.





DESIGN INPUTS:

Key Requirements:

- *Temperature Regulation*
- *Light Bleeding Prevention*
- *Precise Light Control*

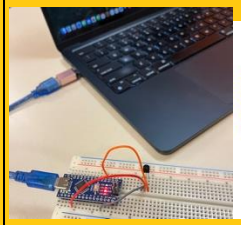
MOST restrictive design constraints

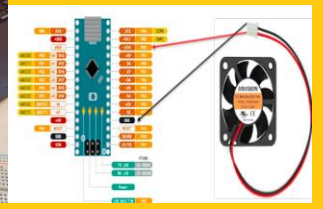
- *Budget*
- *User Interface*
- *High Throughput Capabilities*

FUTURE

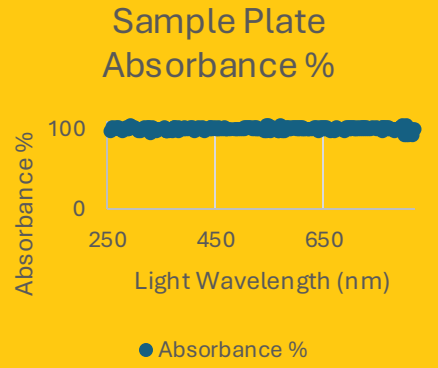
1. *Changing how the temperature sensor is mounted, perhaps modifying the LED plate to include it on the circuit board*
2. *Creating a more efficient power supply method*

Verification Testing





Spectrophotometry verified that the plate material absorbs nearly all visible light, preventing light bleeding as shown to the right.



Sensor tests showed a thermistor can accurately read temperatures and activate a cooling fan when necessary (shown above).

BUILD

While building this device we decided to add wiring channels to the box design to safely route the wiring and electricity. We also modified the size of the device, so it is compatible with the size of the 96 well plate and so it can fit the Arduino mega and the raspberry pi. The CO_2 valve was also a feature that was added in case we have to anesthetize the flies.