

# JMP at MA State High School Science Fair:

## Phototropic and Rotational Effects on Germinating *Brassica Rapa*



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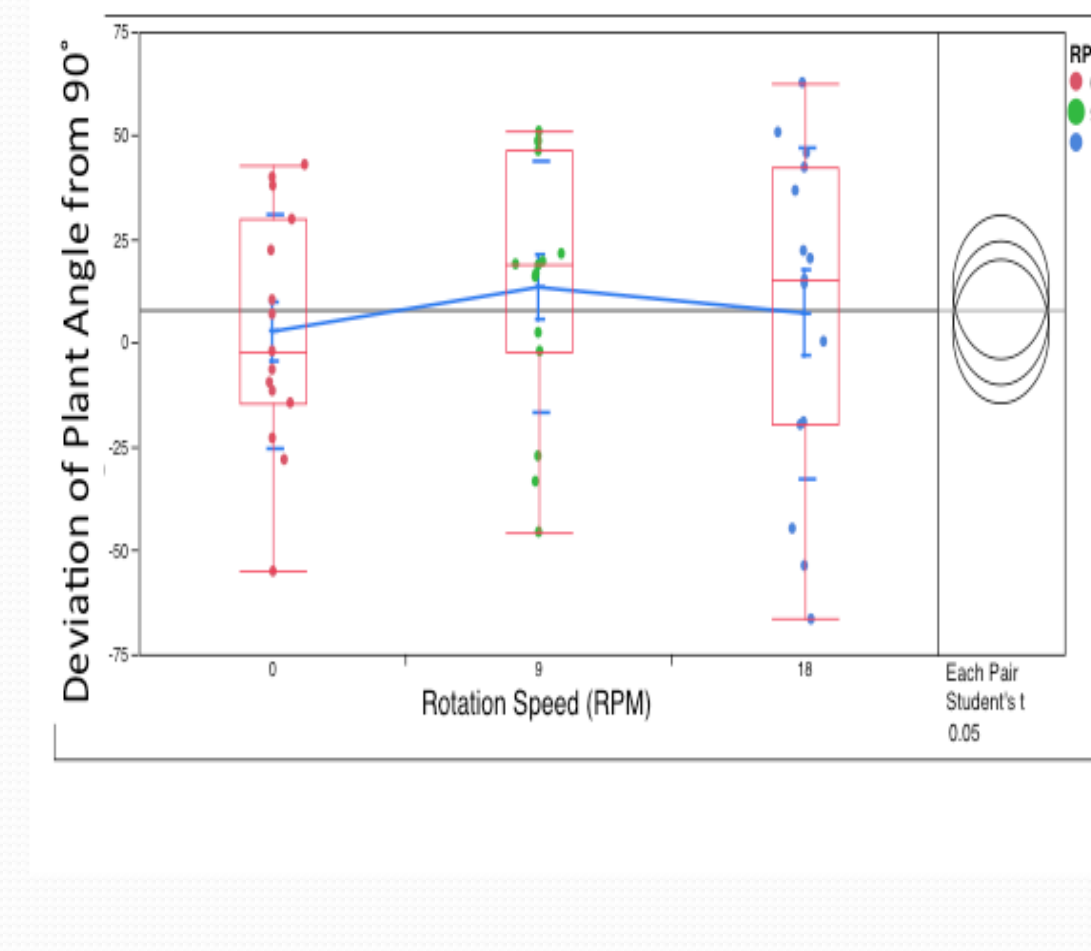
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### Abstract

The purpose of this project was to determine the optimum color of light and rotational speed to manipulate a germinating *Brassica rapa* plant's growth. The effect of light on a plant's growth is well documented, as well as the effect of gravity/rotational forces on plants development. However, combining the two variables, during the initial germinating stages of *Brassica rapa* is not. It was hypothesized that blue and white light would have the greatest phototropic effect, while increasing the rotational speed would increase the angle of deviation from vertical plant growth, along a vector perpendicular to the axis of rotation. A custom rotational apparatus was built to spin 2 towers each with 15 film canisters, each of which contained 2 *Brassica rapa* seeds. Each film canister had one pair of LEDs of the possible combinations of the following color LEDs: Red, White, Blue, None, Green, for a total of 15 possible permutations. After 3 days, each plant was photographed, and the angle of growth and the arc length of the plant were measured using Graphite®, a CAD program. The results suggested that rotational speed had no statistically significant effect on either angle of growth or arc length. The results also suggested that blue light had the greatest phototropic effect. A conclusion could not be made about the effect of color of light on the arc length, due to a large statistical variance. The results from this experiment could be applied in industrial greenhouse environments, where the ability to manipulate a plant's growth could be beneficial, either due to more efficient usage of space, or simply aesthetically.

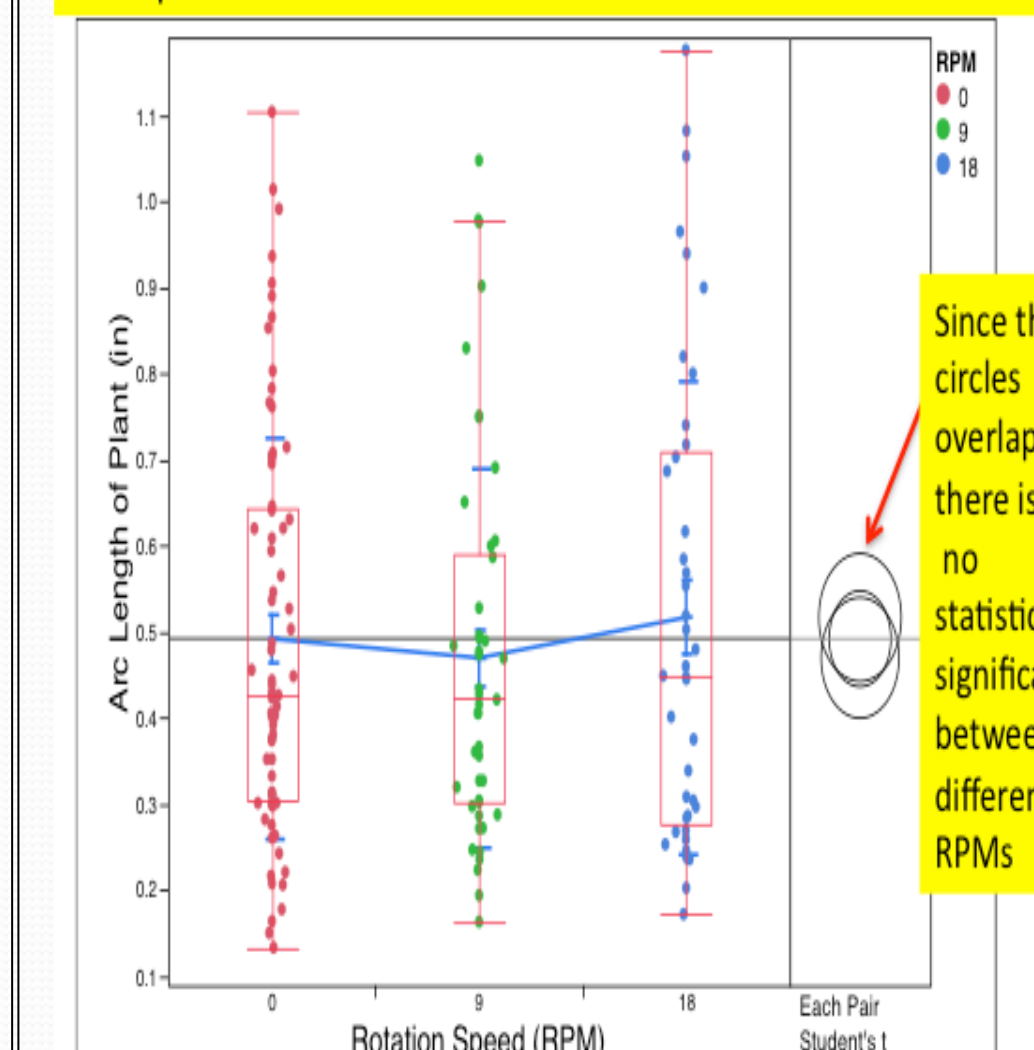
### 1. Rotational Speed vs. Angle of Growth

There is no significance of RPM v. the angle of plant growth per color pair. The angles of the plants deviation from vertical (0°) between the data sets is not statistically significant.



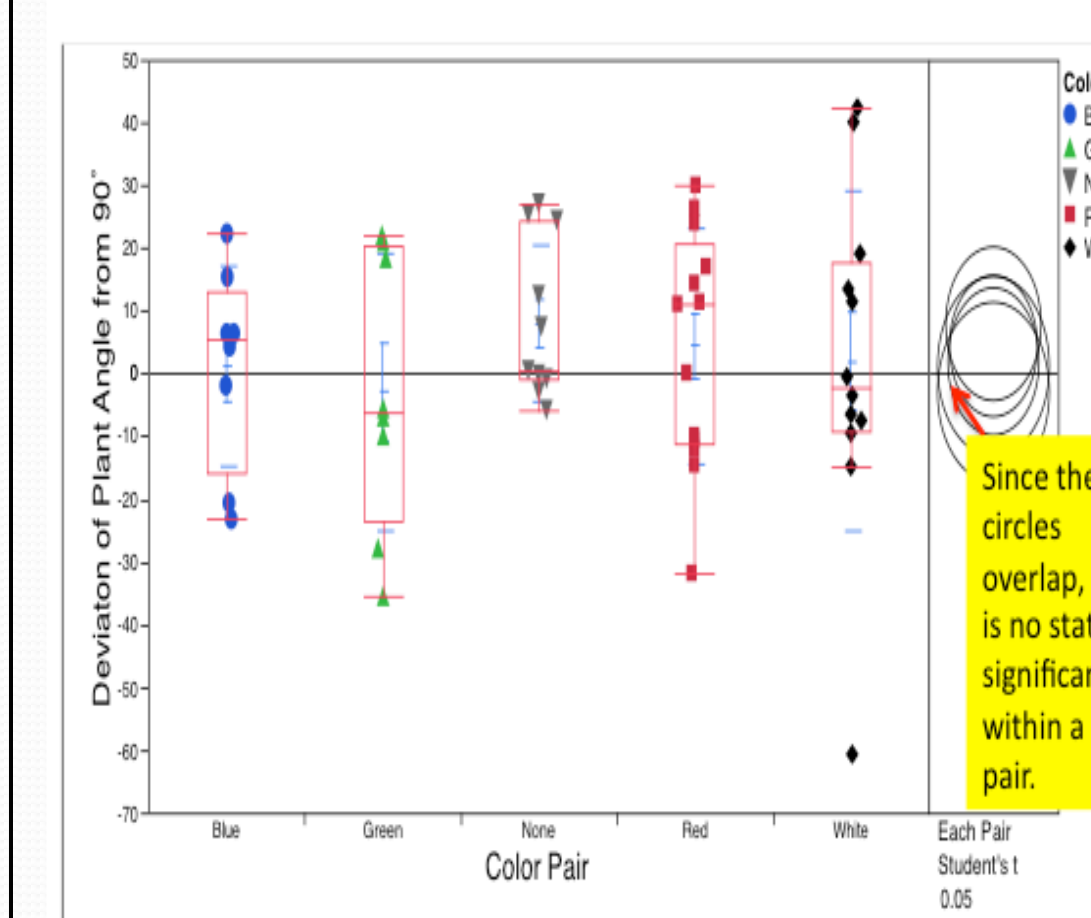
### 2. Rotational Speed vs. Arc Length of Plant (in)

There is no significance of RPM on the length of the plant per color pair.



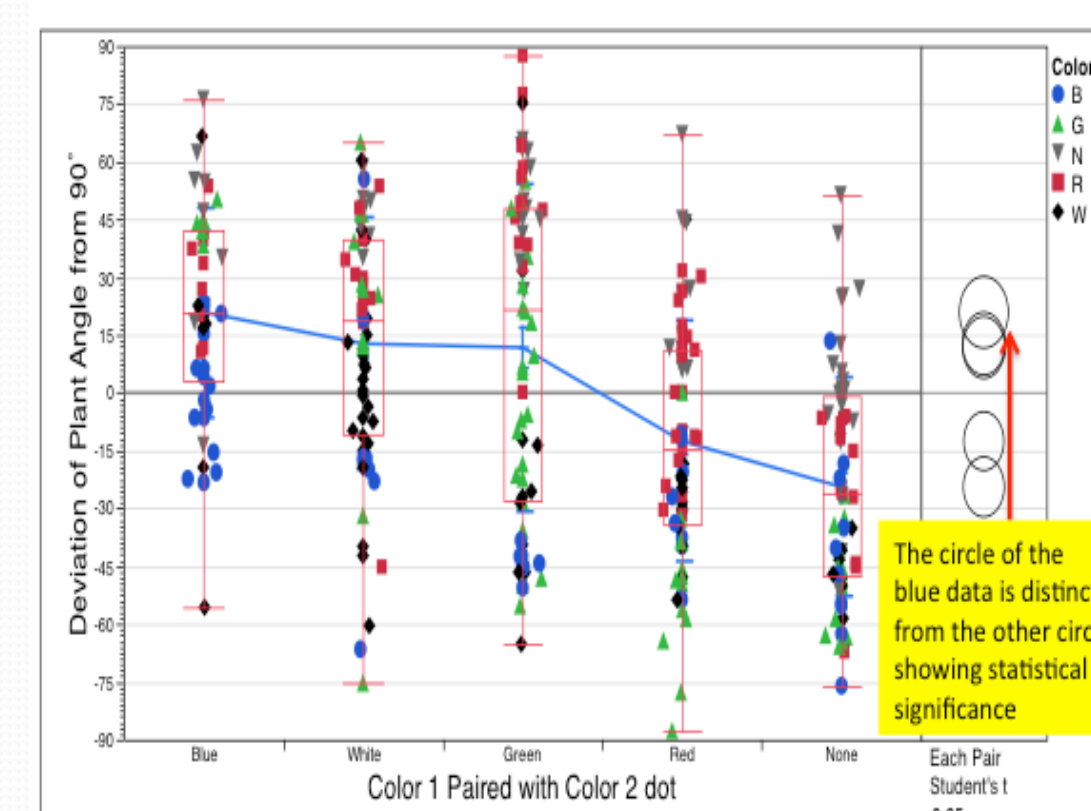
### 3. Same Color Pair vs. Angle of Growth

When both LEDs are the same color, all the combinations produce plants that have mean angles of growth within 12° of 90°, meaning they grow perpendicular to axis of rotation.



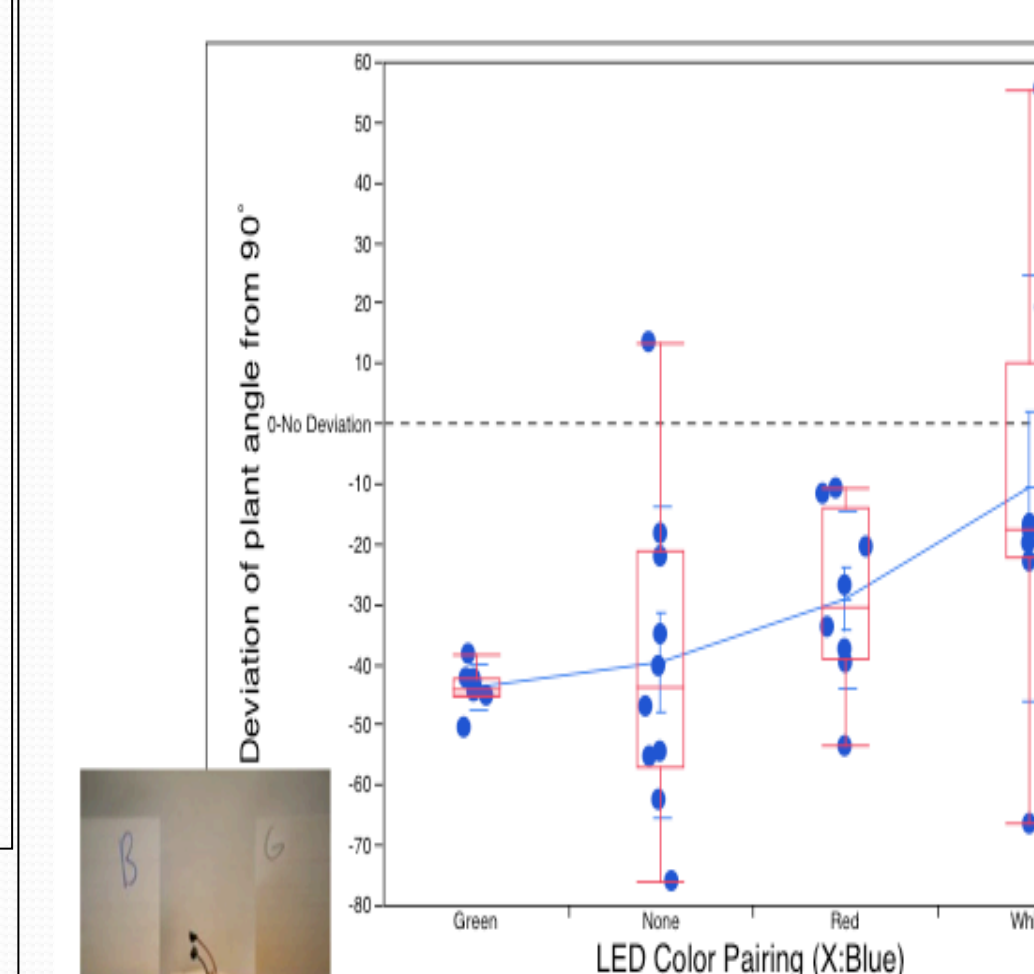
### 4. All Data: Color Pair vs. Angle of Growth (all RPMs)

This graph shows that the color of light is significant in determining angle of growth.



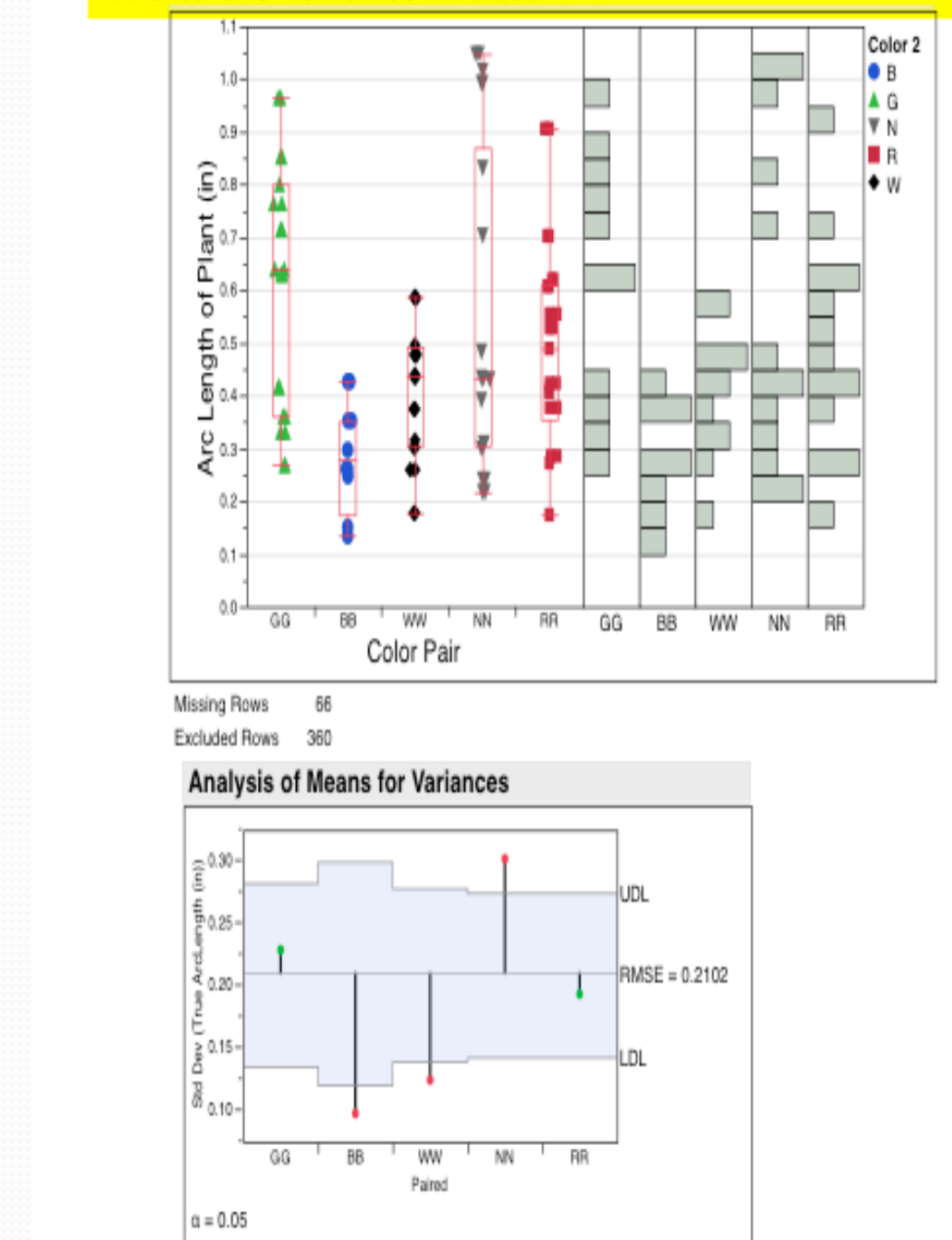
### 5. X:Blue color pair vs. Angle of Growth<sub>Blue</sub>

The negative angle of the plants indicate that the plants always bend towards the blue light when paired with other colors. Blue is the most effective color at manipulating plant angle.



### 6. Same Color Pair vs. Arc Length of Plant

We are excluding results regarding Color and Length due to the variance in data.



### Measurement Methodology

CAD program used to measure arc length and angle of deviation w/ scale factor

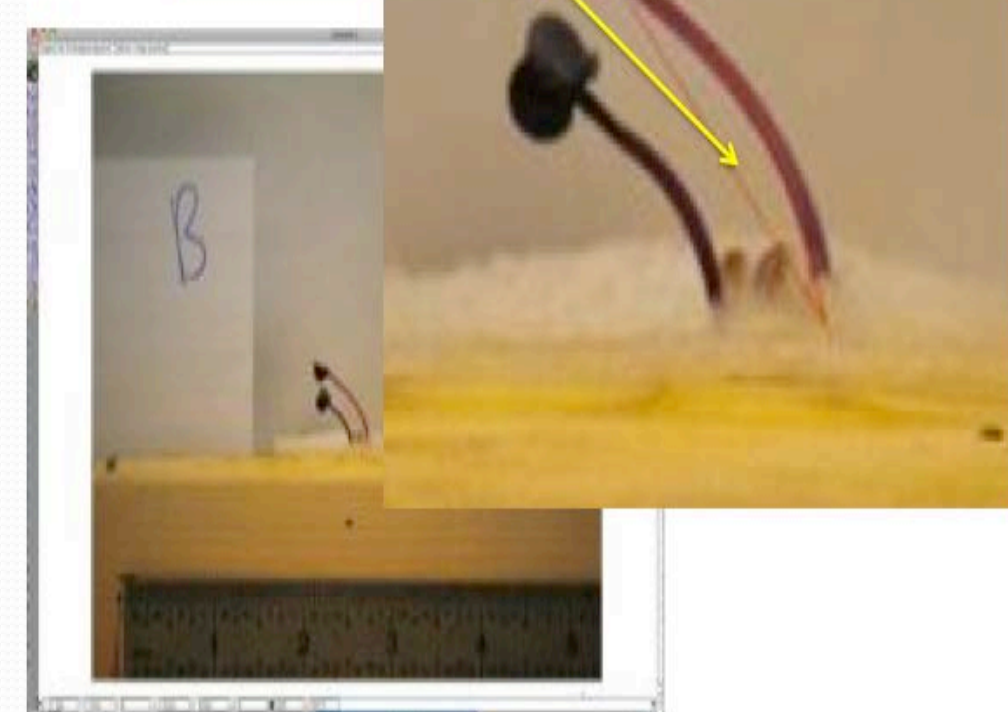


Fig. 1: Rotational apparatus.

### Results

In this project, we investigated the phototropic and rotational effects on germinating *Brassica rapa*, through the use of a novel apparatus. The conclusions that we drew from our experiment were: 1) rotational speed has no statistically significant effect on the angle of growth or arc length. Increasing the rpm did not significantly increase the plant's angle of growth, or reduce arc length (Figures 4 and 5). 2) Blue light had the greatest phototropic effect on the plants angle of growth; In 96% of the trials involving a blue LED, the plants grew towards blue (Figures 7 and 8). We could not draw a conclusion about the phototropic relationship between light color and arc length, due to the bimodal distribution and large statistical variance in the data.