

# Do lentils sense a wider light-wavelength spectrum than an electronic sensor?

The aim of this project is to compare the spectrum of light-wavelength that lentils sense in comparison on which spectrum does an electronic sensor perceive.

## Materials:

For the biosensor:

- Green lentils
- Cotton
- Water

For the electronic sensor:

- Adafruit light sensor TSL2561
- Arduino Leonardo
- Cables

For the light exposure:

- Different LEDs of different wavelengths:
  - UV
  - Blue
  - Green
  - Red
  - IR
- 19 boxes (to prevent external light to reach the lentils)
  - 15 boxes for non-control experiences
  - 4 boxes for positive and negative controls
- Black scotch

## Protocole:

### To prepare the boxes:

- To make the plans, “makercase” was used, with the following settings:

Easy Laser Cut Case Design

Case Dimensions

Units  
Millimeters

Box Width  
95

Box Height  
95

Box Depth  
95

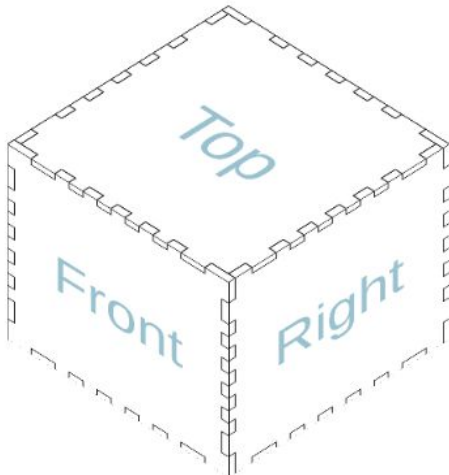
Are these inside dimensions or outside dimensions?  
Outside Inside

Material Thickness  
3mm  
Custom Material Thickness

Edge Joints  
Flat Finger T-Slot

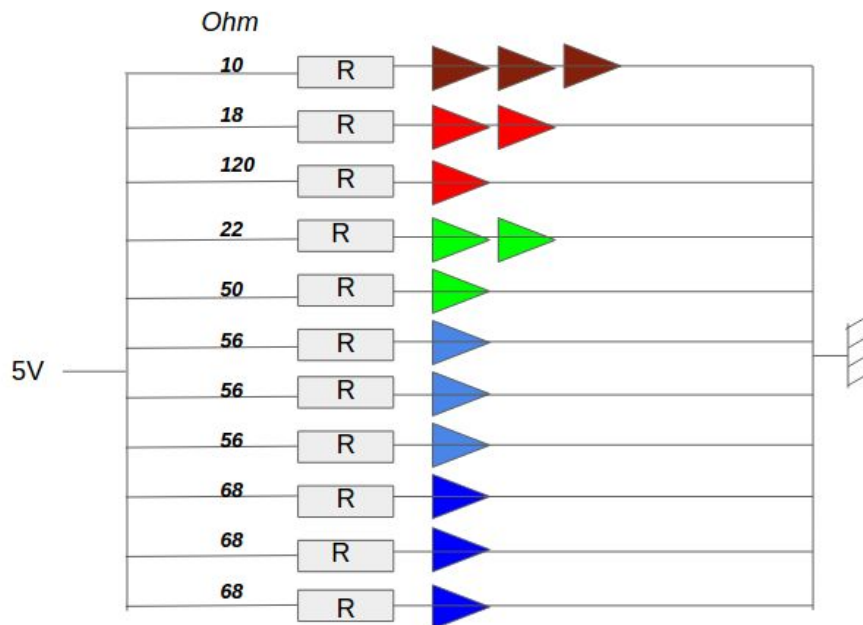
Case Preview

Drag to rotate case. Double-click a face to cut holes and engrave text.

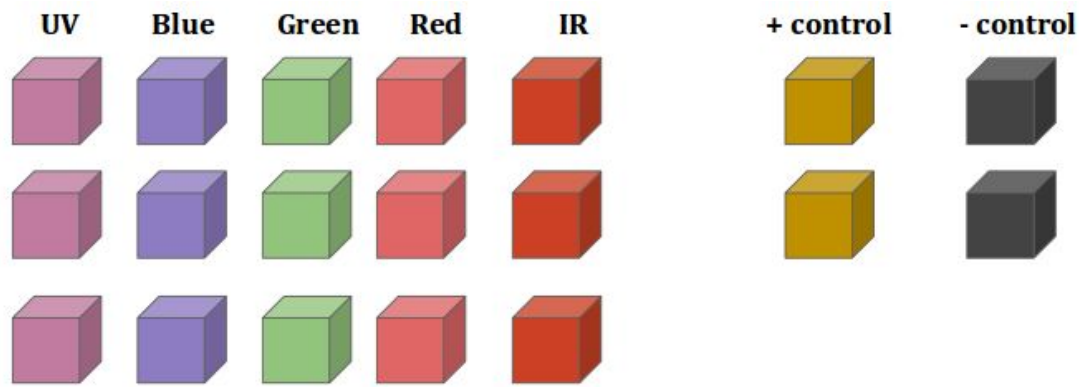


- Then, once the plans exported to the computer, CorelDRAW Essentials X6 was used to send them to the laser cutter (Epilog Laser mini).
- The used wood was 5mm thick (boxes one to five) or 3mm thick (boxes six to nineteen).
- The boxes were assembled and then scotched with gray scotch (all the parts except one, that will serve to open/close).
- For the non-control boxes (boxes one to fifteen), the light system was prepared in the following way:
  - LED were put on the inside of the box with both of its terminals *protruding* outside.
  - They were scotched: terminals won't move and external light won't enter the box.
  - They were attached to cables and then to PCB boards. UV leds were welded together and then all the others were welded together too.
  - For the alimentation, we used two sources: 2 identical chargers producing 5V and 2.1 A.
    - Chargers were composed by a transformer and a USB cable.

- The end of the USB cable was cut and weld into the ends of the circuit thanks to the PCB boards.
- All LEDs will be powered on the same way, so the conditions in every box will be the same.

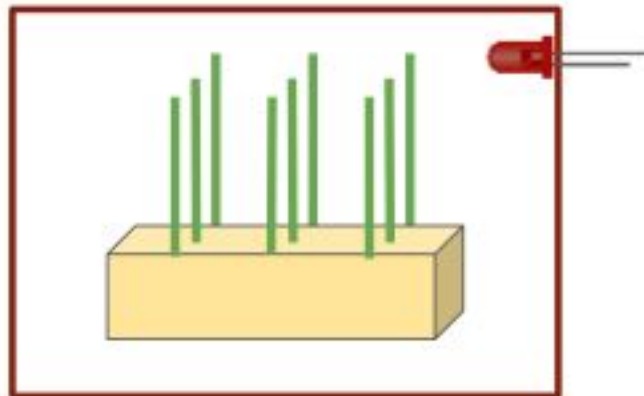


- For the control boxes (box sixteen to nineteen):
  - Positive control:
    - 2 boxes without a LED nor scotch to cover the hole: to let exterior light enter.
  - Negative control:
    - 2 boxes without a LED but with scotch in the hole: without light exposure.
- We put cotton on the inferior of each box to create a place where to grow lentilles.



To test the biosensor:

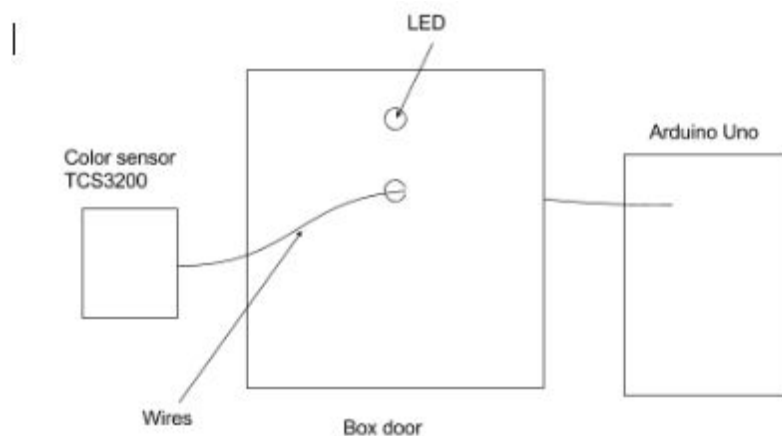
- Germinated-in-the-dark lentils were taken: they were ready to grow but hadn't a sprout yet.
- 9 lentils were distributed on the different boxes in the following way:



- The lentils must be on the cotton and separated by one inch of each other.
- Lentils of each box were photographed before the box were closed.
- All boxes were closed in order to start the experience.
- After 18h of the day after the boxes were opened.
- Lentils of each box were photographed in order to be able to analyze its growth.

### To test electronic sensor:

- After the lentils experiment was done, the boxes were reused to test the Adafruit light sensor TSL2561 and know which spectrum does it sense.
- The sensor was put in the middle of the boxes as in the schema:



### Data analysis:

- Biosensor:
  - We measure the size of the plants and direction of lentils sprouts.
  - From this image we do the data analysis:
    - We count how many sprouts have grown towards the light

- We do a % of sprouts that have moved (out of the total) and put it in a graph in relation with the wavelength.
- Electronic sensor:
  - The caption of those wavelengths will be also added in a graph in relation to the intensity.