We had started off thinking of how we can unite physics and biology together in the same experiment. After thinking about plants and electricity we thought we could see if electrically functioning lights can succeed in substituting the sun light. We had decided to use two different artificial lights with different colors and the sunlight. We had also thought that we would need a plant that is easy and a fast grower. We couldn't provide ourselves with some genetically modified seeds as we didn't have the contact, but instead we decided to use lentils as they are the fastest growing plant we had the possibility of acquiring. We then thought about the soil in which the plants would be placed. We thus decided to also have three different types of soil. The first is organic, the second is moist organic, and the third is woody soil. The next problem was the question of how to set up the apparatus. What is required out of the apparatus is that it can provide a close environment that would not let any light come in. the main goal is to be able to feed the plants with only the artificial lights, it must be ensured that no other alien light can come in. The containers we used had some holes to allow for oxygenation, they were cardboard boxes. The fact that they were cardboard boxes made them easier to craft and manipulate to our desire. The dimension of the 2 boxes was of 36cmx27cmx14cm, which was the closest we could obtain to perfect. The best measurements we could've obtained would've been of at least the double. The next part of the strategy is to install the lamps inside the boxes in such a way so that it could give equal amounts of light to each of the set of plants. We did so by cutting a perfect hole halfway on the top part of the box, in such a manner that when the lamp is placed it would shine on the plants. Inside the box are three 8x8x8 pots, each with a different kind of soil. The main problem that we have faced now, is how we would keep the plants watered, and of course we cannot keep the lights on for 24 hour cycles, seeing it would not give a properly accurate simulation of the sun light and would risk burning the cardboard. This is necessary for the timing was bad, the experiment was set and needed maintaining during a period in which we would have to be absent. We had the least trouble with the control, as we only had to place it in a window which had a lot of sunshine, and water it, like a normal plant. We have resolved the problem of the light being kept on for some periods of time by the use of a timer which would be programmed to turn the lights on and off as desired. We decided to program the timer to have 40 minute intervals between each 20 minutes of "shining" sessions. The reason behind the long interval is because of a few reasons. First we were afraid that if the light was kept on for long it would set the cardboard on fire, as the filament might heat up to such an extent it would be hot enough to set fire; which meant danger for the entire establishment. The second reason for this interval is because we worried the intense heat inside the box might kill the plants. To keep the plants watered whilst not being there we had a supervisor able to do it, water them for us twice a day, when he arrived to the work place and before he left. We had chosen to put 18 germinated seeds in to each pot. This was to increase the chances of growth as we didn't know which was the optimum depth the seeds had to be planted at. The germinating of the seeds took 24 hours. The temperature inside the boxes reached some 44 degrees, otherwise it would stay at ambient temperature. We had three sets of three pots with different soils. One with a yellow light, another with a purple one, and another that was in the natural state, which was used as a control. The natural set was sunbathed with natural sunlight. The color choosing was set with an intensity measurer. The given intensities were that the purple light gave off a 4,0 lux intensity and the yellow one a 3.76 lux

intensity. We had hoped for greater difference in intensity but this was the best we could do. The experiment was recorded for a period of 12 days. We then needed to record the temperature inside at different times to make sure it didn't get too hot. We would see which set grew the best, measuring the tallest lentil with a ruler. Change would be measured each day with a ruler. The pots were differentiated by use of markers, the red marker symbolized woody soil, the white symbolized the organic soil, and the green stood for moist organic.

My hypothesis was that the woody soil would be the worst for plant growth, and that the most organic may be the best. The best results would be seen in the purple light as it had a higher intensity (not taking in to account the control).

See final page for apparatus diagram

So to summarize the tools we used are the following:
A pair of scissors to cut cardboard, 2 lamps of different color to vary intensity (purple and yellow), 2 cardboard boxes with 36cmx27cmx14cm dimensions, a timer (working by cutting off electricity when wanted to), woody soil, organic soil, and moist organic soil, lentils seeds, nine 8cmx8cmx8cm pots, water, sunlight, a thermometer and a ruler to measure change. markers to mark the pots carrying the different types of soil to deferentiate the soils between each other.
The results are the following:

Organic	Day 1	Day 5	Day 6	Day 7	Day 11	Day 12
Purple light	0 cm	1 cm	1 cm	1.5 cm	died	Died
Yellow light	0 cm	0 cm	0 cm	0 cm	0 cm	0 cm
Natural sun light	0 Cm	7 cm	10 cm	14 cm	17 cm	18 cm

Woody	Day 1	Day 5	Day 6	Day 7	Day 11	Day 12
Purple light	0 cm	0 cm	0 cm	0 cm	died	Died
Yellow light	0 cm	0 cm	0 cm	0 cm	0 cm	0 cm
Natural light	0 cm	0 cm	1 cm	3 cm	6 cm	7 cm

Moist organic	Day 1	Day 5	Day 6	Day 7	Day 11	Day 12
Purple light	0 cm	2.5 cm	4.5 cm	5.5 cm	died	Died
Yellow light	0 cm	0 cm	0 cm	0 cm	0 cm	0 cm
Natural light	0 cm	5 cm	9 cm	12 cm	15 cm	16 cm

The firs thing that we notice is that the yellow light has no growth what so ever. This is strange as it has a lower intensity than the other lights. What is probably is that the seeds were killed due to heat, and lack of water. Not to mention that yellow is very close to green on the light spectrum. This means that the plant can't use much of the yellow light to grow. The reason for which the plant is green to our eyes is because it's the only color it is not, in the light spectrum yellow and green are very close. Having a green light shine on the plant would result in worse results (if that is possible).

As we were unable to be present during the experiment to overview it for a great majority of the time, we didn't get very consistent results. What would've been optimum would've been a day by day measurement. What I ended up doing in order to have an idea of the exact rate of growth is divide the final length of the plant by the number of days. As the yellow light gave no results what so ever, the only thing that could be done was to compare results from the purple and natural lights, not to mention it had a lower intensity than the other lights. It was something that could've be anticipated.

The seeds that were planted in the moist organic soil were highly successful in the exposition to the natural light. For some reason, the plants died around the 8th day. We know so as the main reason was probably from lack of watering. We had measured the plants form the batch the 7^{th} day and it turned to be 5.5 cm. when we came back on the 11^{th} day of the experiment we had seen there was no change, and the plant was still at 5.5, but obviously dead. What can be studied is the difference in the growth in the first seven days between the two plants. What is remarkable is that the naturally lit plant has a steeper line than that of the artificially lit plant, much steeper. There is a geometric difference, this is deduced as the distance between the two lines increases with time, meaning the naturally lit plant is growing faster than the artificially lit one. Though the artificially lit plant died soon in to the experiment, I added a line following the trajectory of the original line to be able to have an educated guess about the growth that would've taken place. By the end of the experiment there would be a 7.5 cm difference with the advantage to the naturally lit plant. That's almost twice the size of the artificially lit plant. If we compare only the soil VS light data, we can only conclude that the natural light is best for the seeds in moist organic soil.

The results for the woody type soil were terrible. As the soil wasn't purely soil, the seeds had more obstacles to face in growth, making it more difficult for them. The only one that succeeded in growth was the naturally lit plant. But that didn't go far either with a maximum length of 7 cm, compared to other results from the bright light (longest plant being 18 cm) 7 cm is not good. This goes to show us that the plant is not adapted to grow in woody type soil. The soil was also not very dense showing that there might not be that many nutrients for the plant either. It's understandable that the sunlit plant had the best result, seeing the sun gave it more of the nutrients it needed. With the growing demands of nutrients as a plant grows the plant would've died soon anyways as the soil didn't provide it with that many nutrients.

Finally the organic soil is very intriguing. It allowed for greatest growth in the sunlit plant, but not the best for the purple lit plant. In this case too I drew an extension on the purple lit plant graph, as the plants had died around the 8^{th} day as well. Because the sunlit graph is much steeper than the purple lit plant, the line extension only showed that the plant would've been 4 cm long, which is worse than it had done in the moist organic soil. The question is why?

The hypothesis was proved right, the purple light had better results than the yellow one but for different reasons than was anticipated. As for the best soil for growth, that was a harder answer to question as it varied because of light. This could've been due to different environmental factors.

Run off experiments should be run to answer certain questions, such as what is exactly more important: Soil or light? This experiment should be repeated a few times itself, as it had many errors. The artificial lights were chosen without knowledge that the yellow spectrum is close to the green one thus the plant cannot use it, not to mention that we should've kept in mind the intensity of the lights. The lights we used had a very low intensity compared to that of the sun. So now there are to variable to test, how different intensities and different colors affect plant growth should be the research question to the next experiment. What was wrong with this experiment is that there wasn't enough control to it. Most of the time we were unable to be there to observe what's going on. The data was very imprecise, and the lack of presence resulted in the death of most plants. To make this experiment the monitoring of the plants should be made possible, for instance by having less things to do for the scientists doing the experiment in question.

The temperature was a variable that wasn't the same in all apparatuses. The temperature was ambient for the naturally lit plant, and it changed for the two other sets. This is something that was different and therefore could've skewed our results. It would be good to obtain some high intensity color lamps which would stay cool somehow, so as to have the plants have the same temperatures. The change wasn't great, the temperature achieved 42 degrees inside the boxes, and when it cooled down for 40 minutes, it came down to ambient temperature.

The amount of soil was not measured and the amount of seeds planted might not have been too many for the small box, and some of them might not have been properly germinated.

This kind of information is necessary for it helps us find out what is the optimum most efficient mean to grow the biggest plants. This could then help us grow more food, and feed more people in the world. What is to be doubted is that maybe different plants have different means of growth. As the tomato is red, it might prefer different colors than lentils.

In conclusion this experiment was not run properly. The results were not precise enough as they didn't fit together at time. An example would be when the organic soil gave better results for the sunlit lamp, and the moist organic gave the best results for the purple light. What can be deduced from this experiment is that yellow light isn't good for growing plants, but this should be tested further as well. Other colors should be tested out, and on different plants as well as different soils. For these results might only apply to lentils. So far, the natural way seems to be the best way for plant growth.