

LOGBOOK

November 27 2020:

My main task today was to find some testable questions for my experimental project. I went on the website www.sciencebuddies.org to find a good project to work on. I had to find a project that was for my grade level so I searched in that section of the website. The first experiment I found was " Which Filtration Method Leads to the Best Drinking Water ? " It seemed like a good experiment because it only required up to 5 days and a budget of \$50.00. But it was a seventh grade level project, so I decided to look for other experiments. The next project idea I found was " Genetically Engineer Yeast to be Fluorescent." It was another very interesting project but it was for a higher grade level and required more specific equipment to do the project. I also didn't think it was an experimental project because it didn't have any testable question. I found an experiment that was for my grade level and it was to " Make Your Own Shampoo and Test How It Performs. " The project had a \$50.00 budget and would take up to 5 days. In order to test the shampoo, you would use dirty wool to represent your hair, and measure the mass of the dirt and grease that was removed by the shampoo I made. I would use these two recipe from the website to make my shampoo:

Recipe 1: Coconut milk shampoo		Recipe 2: Castile soap herbal shampoo	
Ingredient	Amount	Ingredient	Amount
Coconut milk (full-fat)	1 can	Herbal-infused water	4–5 oz
Honey	2 tablespoons	Castile soap	2 oz
Jojoba oil	1 teaspoon	Jojoba oil	0.5 teaspoons
Olive oil	1 teaspoon	Essential oil aroma	1 teaspoon
Apple cider vinegar	2 tablespoons		
Essential oil aroma	1 teaspoon		

Table 1. Recipes for the two organic shampoos you will test in this project.

November 28 2020:

Today I continued to search for more project ideas, on the same website I used before. The first experiment I found was "Measuring Glucose in Your Food." It was my grade level, it would only take one day to do the experiment and the cost was \$40.00 to \$80.00. There was also a kit available. I added it to my list of science fair ideas. So far I have 4 topics to choose from. I continued exploring for more. I found an experiment about light. The testable question is "Does Light Intensity Change with Distance?" This project was my grade level, it would only take one day and the budget was only \$20.00. To measure the intensity I would use the Science Journal app which would measure the intensity of light as I moved the device further from the light source.



I would use this table to record my results:

Light Intensity Measurements				
Distance from light source [cm.]	Trial 1 [lux]	Trial 2 [lux]	Trial 3 [lux]	Average of trials [lux]

November 29 2020:

I have 5 topics to choose from so far. Today I added two more ideas to my list before submitting it. Those two were research project ideas and both of the same area in science, human biology and health. The first one I found today was "How can Vaccines Be Used to Fight Outbreaks?" I thought this was a good topic considering the pandemic right now. It is my grade level and would require up to 5 days. The last topic I found was "Model How R naught Shapes an Epidemic."

December 2 2020:

I found seven topics in total and today I decided what my testable question would be. My final decision was that I was going to do an experimental project, so I was not doing the two research projects and the fluorescent yeast project. The filtration experiment was a good idea but I was unsure about how I would get the most accurate results. It was also below my grade level. So the last two topics I had left were "Make Your Own Shampoo and Test How It Performs" and "Does Light Intensity Change with Distance?"

The shampoo experiment would require up to 5 days and \$50.00, while the light intensity experiment would require only 1 day and \$20.00. I chose my testable question and experiment to be Does Light Intensity Change With Distance?

December 11 2020:

Today is the first day of winter break, so I got started on my background research. My testable question is about light intensity changing with distance, so I think it would make sense for me to start writing about light in my background research. Visible light is a portion of the electromagnetic spectrum, so today I'm writing briefly about every type of radiation. In the Light and Optics unit in science, I learned about the electromagnetic spectrum, so for each radiation I started with what I knew and researched even more about it. This is what I researched today:

Radio waves:

- They have the least frequency and the greatest wavelength in the electromagnetic spectrum.
- They are used for transmitting information from one place to a different place, and they carry signals for phones, TVs, air traffic control, radio navigation systems and wireless networks.
- There are different wavelengths AM to FM.

Microwaves:

- They have shorter wavelengths and a higher frequency than radio waves.
- They are mainly used to heat up food.
- They are also used to transmit information from one location to another.

Infrared waves:

- To humans, they are felt as heat.
- Some insects and animals are able to see infrared radiation.
- They have a range of wavelengths like visible light, far infrared and near infrared.
- Applications are security, remote controls, electric heaters etc.

Visible light:

- The only portion of the electromagnetic spectrum that humans are able to see.
- 0.0035 percent of the electromagnetic spectrum.
- Have a range of wavelengths, red orange yellow, green, blue, indigo, violet.
- Red to violet is largest wavelength to shortest wavelength, lowest frequency to greatest frequency.

December 13, 2020:

Ultraviolet Light:

- Also known as Uv light.
- Many animals are able to see Uv light.
- Has a range of wavelengths, Near UV, far UV, and extreme UV.
- UV used to treat Jaundice.
- UV lamps used in hospitals to kill microorganisms in equipment.
- Too much UV exposure causes sunburn
- UV exposure causes tanning.

X-rays:

- Mainly used for medical imaging.
- Can pass through muscles and tissues, but not bones,
- Different types of X-rays : mammograms, computed tomography, fluoroscopy etc.
- William Roentgen first documented X-rays.

Gamma Rays:

- Highest energy and frequency in the electromagnetic spectrum.
- Shortest wavelength in the electromagnetic spectrum.
- Very dense and thick material is needed to stop gamma rays from travelling.
- Produced by nuclear explosions.

December 15, 2020

Today, I worked on gathering information about the nature and characteristics of light.

- It travels in straight paths.
- It is a stream of photons travelling in waves at the speed of light in vacuum.
- White light travels fastest in vacuum.
- It travels exactly 299 798 km per second.
- It can go around Earth 7.5 times in one second.
- Through the ages, scientists have used many methods to find the exact speed of light.
- The first reasonable measurement was made by Ole Romer.
- There are primary and secondary colors of light.
- Primary colors: Blue Red Green
- Secondary colors: Yellow Magenta Cyan

December 19 2020

- For a long time, scientists have been arguing whether light is a particle or a wave.
- Sometimes through experiments light would be proven to be a particle, and sometimes a wave.
- The particle theory of light was first introduced by Pierre Gasendi, Sir Isaac Newton expanded it even more.
- Christiaan Huygens argued that light was a wave.
- Italian physicist, Francesco Grimaldi discovered light diffraction and related it to the behavior of waves.
- More scientists started to believe that light is actually a wave.

- Albert Einstein believed that light was a photon and the flow of photons was a wave.

December 24, 2020

- Visualizing light as a wave explains some of its unpredictable behavior.
- Waves have a crest, rest, trough, amplitude, wavelength and frequency.
- The crest is the highest point of the wave.
- The trough is the lowest point on the wave.
- The amplitude is the vertical distance from the rest to the crest or trough.
- The wavelength is the horizontal distance between two crests.
- Frequency is the number of cycles the waves complete in a given time.
- Frequency is measured in Hertz.

December 30, 2020

Since my project is about light, I decided to also add a timeline of the study of light. The earliest foundation on research about light started in ancient Greece.

- **600 B.C** - Pythagoras was a mathematician and he attempted to explain the concept of vision. He claimed that light beams exit our eyes, and anything the beams touch, we would be able to see. The problem with this theory is that we are not able to see in the dark.
- **300 B.C** - Euclid was a Greek mathematician. He summarized the concepts of optics such as vision, reflection and diffusion in his book called *Euclid's Optics*. He claimed that light travels in straight lines and also initiated the mathematical formula for refraction and reflection.
- **160 A.D** - Ptolemy was a Roman astronomer. He wrote about refraction and described how light beams bend when they go from air to glass. He also further established the emission theory of light.

- **984** - Ibn Sahl was a Persian physicist and mathematician. He wrote *On Burning Mirrors and Lenses* which demonstrated his understanding of how curved mirrors and lenses were able to bend and focus light.

January 5, 2021

I continued my timeline:

- **1000s** - Ibn al-Haytham was an Arab astronomer, physicist and mathematician. He is known to be the father of optics and wrote major works including his Book of Optics. The Book of Optics shows his observations and experiments on light being reflected and refracted using lenses and mirrors. Ibn al-Haytham also stated that vision actually takes place by light rays entering our eyes, this is the intromissionist theory.
- **1200s** - Roger Bacon was an English philosopher. In 1250 he discovered that light reflects off of objects, and doesn't get released from them.
- **1604** - Johannes Kepler was a German astronomer and mathematician. In 1604, he discovered how vision works and how eyes focus light.
- **1615** - Willebrord Snellius was a Dutch astronomer, he explained the relationship between the angle of incidence and the angle of refraction when light passes through one medium to another. This is called Snell's law, but it was first accurately described by **Ibn Sahl** in **984**.
- **1668** - Sir Isaac Newton was an English astronomer, physicist, mathematician and author. He expanded Pierre Gassendi's idea that light is made up of separate fast moving particles called "corpuscles."
- **1672** - Sir Isaac Newton showed how white light separates into a spectrum of colors when it goes through a prism.
- **1678** - Christiaan Huygens was a Dutch astronomer, inventor, physicist and mathematician. He was the first to introduce the wave theory of light to explain

January 7, 2021

I finished up my timeline

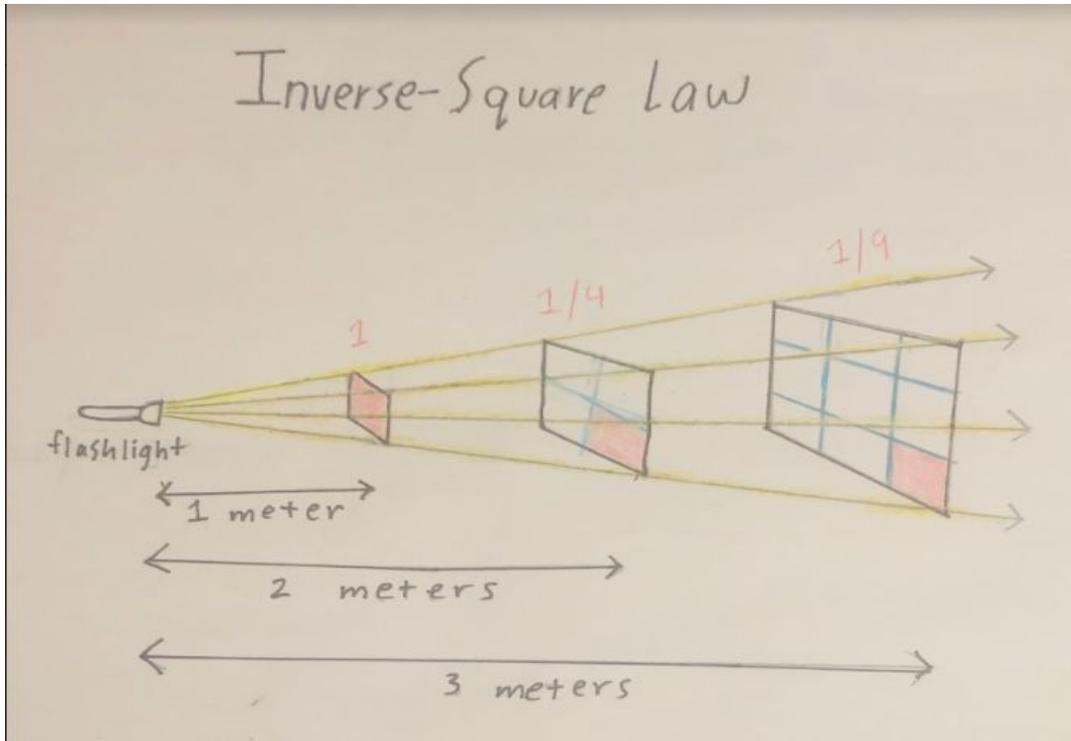
- **1801** - Thomas Young was a British scientist. In 1801 he conducted the " double slit experiment" which gave him strong evidence and proof that light is actually a wave. The particle theory of light had been replaced by the wave theory.
- **1860** - James Clerk Maxwell was a Scottish theoretical physicist. He predicted the existence of electromagnetic waves and explained that electricity, magnetism and light are all indications of the electromagnetic field.
- **1905** - In 1905 Albert Einstein established the photoelectric effect theory, where light is made up of particles called photons.

Since my experiment is on light intensity, I started to research it.

- Light intensity is also known as luminous intensity
- It is the amount of visible light that is given off in unit time per unit solid angle.
- Light intensity is measured in lumens per square meter: lux.
- Lumens is the amount of illumination in a specific area.
- One lux is one lumen per square meter.
- Brightness is how the human eye perceives light.
- Light intensity is a physical quantity

January 10, 2021

Today I researched the inverse square law. I also drew a picture.



The inverse square law demonstrates how the relation between light intensity and distance is inverse.

January 13, 2021

Today I wrote my testable question, hypothesis, variables and materials on my document.

The materials I need are:

- Lamp socket with cord.
- Light bulb (any wattage)
- ruler
- Arduino Science Journal app
- Electronic device such as tablet or phone
- Black poster board
- Black poster paper
- Black Tape

- Dark area with no reflective objects.
- Sunglasses

I tried to find the Google Science Journal, but it turns out that the app's name was changed into Arduino Science Journal. Everything is the same. I downloaded the app on my dad's phone.

January 16, 2021

Today I went to the Dollar store and Rona with my father to get the materials for my project. I got 2 black poster papers, two rolls of black tape, scissors, 2 black poster boards. I already had 4 black poster boards at home, so I also used the We couldn't find the lamp socket with cord.

January 17, 2021

Today, I bought the lamp socket and a small light bulb. I started to make my procedure. I first wrote about how the area should look like.

Area:

- a) Find an area of two by three meters to do the experiment.
- b) Area must be completely darkened, if there are windows nearby, cover them with black poster paper so that it doesn't affect the result.
- c) Cover walls, floor or reflective objects with black poster paper so that it doesn't affect the results. This helps because black is the least reflective color, and absorbs all light.
- d) Cover the wall sockets with black tape, except the socket that the light bulb will plug into.

January 20, 2021

I continued my procedure today, I wrote about the light sensor and setting up the materials to do the experiment.

Light Sensor:

- a) Download " Arduino Science Journal" on smartphone or tablet.
- b) After the tutorial, click the "sensors" icon near the bottom to access the light sensor.
- c) After the "sensors" icon is clicked, it will automatically start recording the light intensity (lux) and the sound intensity (dB). We only need to observe the light intensity.

Setting Up:

- a) Create an observation chart to record the distance from the light bulb (cm), the three trials, and the average of the three trials.
- b) Have the smartphone, light bulb and ruler in the darkened area.
- c) Place the ruler on the black poster paper on the floor.
- d) Place the light bulb on the 0 cm point on the ruler.
- e) Light bulb must be at the same height as the light sensor on smartphone. A ball of clay can be placed under the light bulb so that it aligns with the light sensor.
- f) Smartphone must be able to move smoothly on the ruler to record the light intensity.

January 20, 2021

I finished my procedure :

Experimenting:

1. After the area and light sensor is set up, wear sunglasses and turn on the light bulb.
2. Using the ruler, make a 10cm, 20cm , 30cm and 40cm mark on the floor covered with black poster paper.
3. Place the smartphone at the 10cm point.
4. The app will then tell how intense the light is at 10cm away from the light source.
5. Record the light intensity (lux) in the observation chart in trial one.
6. Do two more trials. In the observation chart, write the intensity in trial 2 and 3.

7. Record the average of all three trials in an observation chart.
8. After all three trials on the 10cm mark are noted, move the smartphone to the 20cm mark.
9. Note down the intensity of light at the 20cm point for three trials.
10. Record the average of the three trials in the chart.
11. Move the smartphone to the 30cm point.
12. Note down the light intensity at the 30cm point for three trials in the chart.
13. Record the average of those three trials in the chart.
14. Lastly, move the smartphone to the 40cm point.
15. Record the light intensity for three trials in the chart.
16. Record the average of the three trials in the chart.
17. In the end, the observation chart should have all the 4 distances from the lightbulb, all 3 three trials for the 4 distances ,and the averages of the trials for all 4 distances.

Cleaning Up:

Turn off the light bulb and put it in a safe place, take off sunglasses since the light bulb is turned off and remove black poster paper from windows, walls, wall socket, floor and any shiny reflective objects that were covered. Put the ruler, smartphone and sunglasses away.

January 22, 2021

Right after I came home from school, I did my experiment. Here are some photos I took:



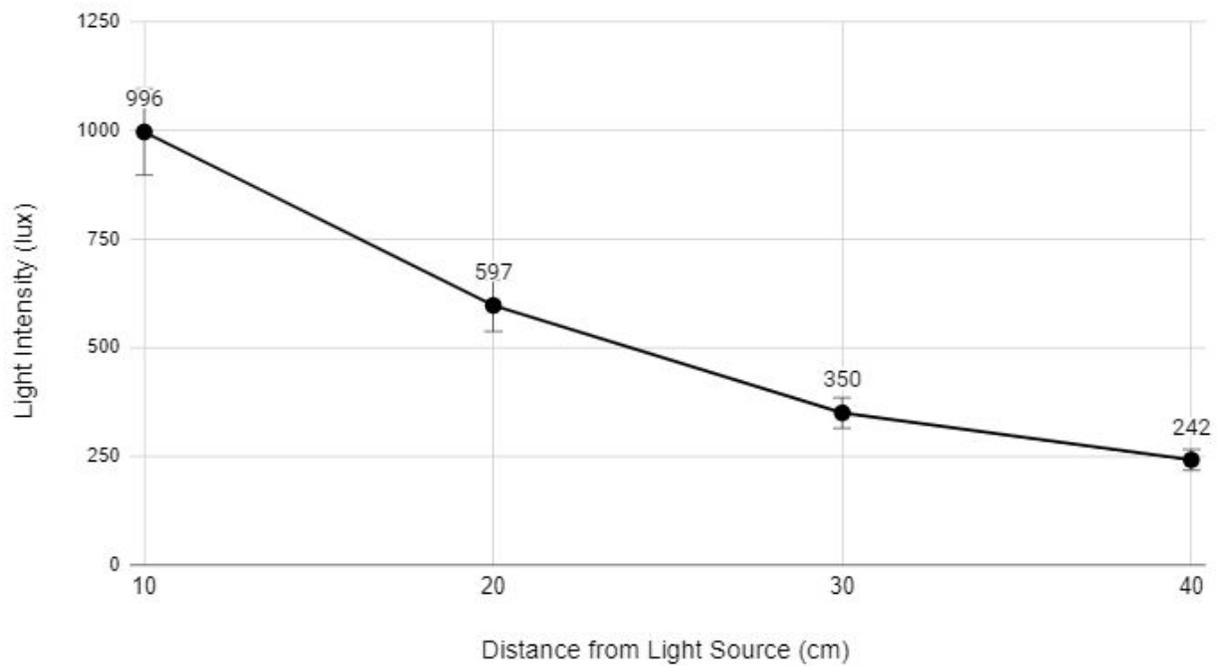


I also made my observation chart and graphs:

Light Intensity Measurements

Distance from light source (cm)	Trial 1 (lux)	Trial 2 (lux)	Trail 3 (lux)	Average of Trials (lux)
10 cm	1K lux	988 lux	1K lux	996 lux
20 cm	600 lux	595 lux	597 lux	597 lux
30 cm	350 lux	353 lux	348 lux	350 lux
40 cm	241 lux	241 lux	243 lux	242 lux

Light Intensity (lux) vs. Distance from Light Source (cm): Average of Three Trials



January 23, 2021

Today I worked on my Conclusion, Application/Extension, and the sources of errors. I also cited all of my sources into my document.

January 24, 2021

I went over and edited everything, I added more detail and information to my background research.