

THE STUDY OF THE AMOUNT OF LIGHT A GLOW STICK EMITS

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ABSTRACT

The purpose of this study was to show which color glow stick glows the brightest, and which color glow stick is longer-lasting. Glow sticks glow due to a chemical reaction. This chemical reaction is called chemiluminescence, or chemical light. One of each color glow stick was taken and the lux was found to see which gave off the most light, least light etc... The green glow stick turned out to be the brightest while the pink glow stick is the longest lasting.

INTRODUCTION

Glow sticks are more commonly known as a fun toy to play with when it is dark outside. There is actually a lot of science behind these seemingly simple toys. Each glow stick contains a glass vial in the center, which is filled with a liquid called phenyl oxalate. Inside the glow stick's outer plastic tube, which is what contains the glass vial, there is another liquid called hydrogen peroxide. Once you crack the glow stick, the two chemicals mix causing a chemical reaction. In this case, the chemical reaction causes the glow stick to emit light or 'glow'. (See Figure 1) Chemical reactions can happen manually or naturally. The five main types of chemical reactions are: combination, decomposition, displacement, redox and combustion. A natural light, such as the firefly, is called bioluminescence. When a chemical light is produced, such as a glow stick, it is called chemiluminescence or chemical light. Lastly, when there is small light, it is known as simply luminescence. Each chemical reaction is made of chemical compounds. Chemical compounds are substances made up of atoms that are bonded together in a rigid structure. In the case of the glow stick, the chemical compounds are the two chemicals that are used to make the glow stick glow. Light is the fastest moving thing in the universe. Light is also a type of radiation that can be converted into different energy forms. The many different colors of glow sticks have different ingredients that are very

long and complicated but are shown here: Blue:9,10-diphenylanthracene, Green:9,10-bis(phenylethynyl) anthracene, Yellow:1-chloro-9,10-bis(phenylethynyl) anthracene rubrene, Orange: 5,12-bis(phenylethynyl)-naphthacene Rhodamine 6G ,Red: Rhodamine B. These are only the typical ingredients used in a glow stick. Each glow stick color is a fluorescent dye that gets added into the hydrogen peroxide. Glow sticks are used for many purposes such as lighting the way on Halloween, safety lights when crossing the street, and lastly, can light the way when scuba diving in the dark depths of the ocean. There are many other ways to use a glow stick as well. A glow stick is easily affected by temperature. When a glow stick gets colder, it gets dimmer, yet lasts longer. When a glow stick heats up, it glows brighter but the chemical reaction stops sooner.

Anand Wong of Cary Academy has studied Light Traveling through Different Solutions. He has figured out that the most light has passed through plain water (8460 lux). He has also figured out that the least light passes through the water with red dye in it. Wong has also tested the amount of light through water with sugar in it and then finding the lux.

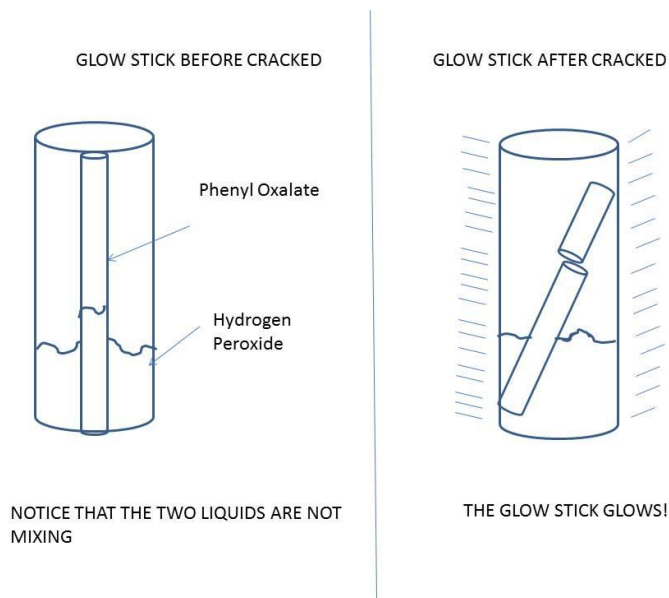


Figure 1: A Demonstration of How a Glow Stick Glows

MATERIALS & METHOD

In these experiments, yellow glow sticks, pink glow sticks, green glow sticks, orange glow sticks, timer, light probe, tablet, and a dark room were used.

During the main experiment, one of each color glow stick were cracked and placed under the light probe. The lux was determined and recorded in Excel. A not lit glow stick's lux was also recorded in Excel.

In the following four follow-up experiments, three of each color glow stick were taken and cracked. The lux was taken and recorded. The glow stick was then allotted to wait five min. After five min, the lux was taken and recorded. The glow stick was then allowed to sit for another five min. The lux was again taken and recorded. This process was repeated until the glow stick had waited a total of fifteen min and the lux was recorded four times

During the final follow up experiment, five green glow sticks were taken. A light probe was stabilized on a small box. One glow stick was cracked and the lux was recorded. As soon as the lux was recorded for one glow stick, another glow stick was cracked and placed beside the first one immediately. The lux was recorded. This process was repeated until all five glow sticks were standing beside each other and the lux was recorded for the final time.

RESULTS & DISCUSSION

During the main experiment, each color glow stick's lux was measured and recorded once, with the one exception of when a glow stick that was not cracked or lit was measured and recorded for the control. The not lit glow stick gave off 0.0 lux, the yellow glow stick gave off 143.0 lux, the pink glow stick gave off 9.06 lux, the orange glow stick gave off 41.73 lux, and the green glow stick gave off 113.3 lux. (See Figure 2)

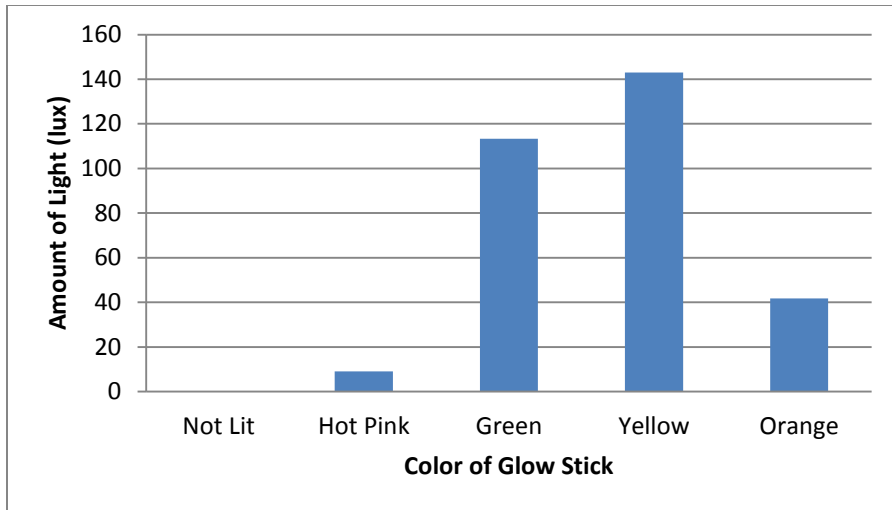


Figure 2: The Amount of Lux that Colored Glow Sticks Give Off

In the second experiment, the yellow glow stick's average lux was determined. At zero mins (right away), the yellow glow stick gave off an average of 105.03 lux. After five mins, the yellow glow stick gave off an average of 22.56 lux. After 10 mins, the yellow glow stick gave off an average of 19.36 lux. Finally after 15 mins, the yellow glow stick gave off an average of 16.6 lux. (See Figure 3)

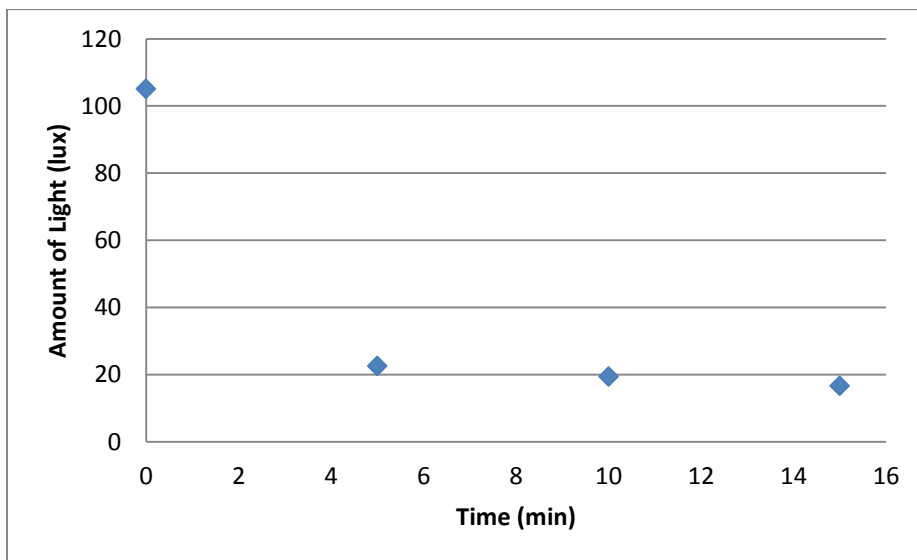


Figure 3: The Average Amount of Lux a Yellow Glow Stick Gives off After Five Minute Intervals

During the third experiment, the orange glow stick's average lux was determined. At zero mins, the orange glow stick gave off an average of 98 lux. After five mins, the orange glow stick gave off an average of 36.6 lux. After ten mins, the orange glow stick

gave off an average of 27.6 lux. After 15 mins, the orange glow stick gave off an average of 22.6 lux. (See Figure 4)

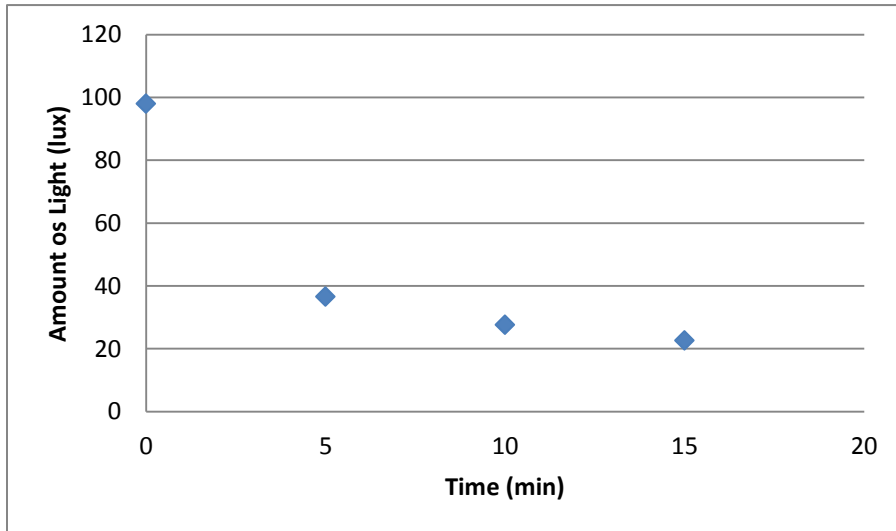


Figure 4: The Average Amount of Light an Orange Glow Stick Gives Off After Five Minute Intervals

During the fourth experiment, the pink glow stick's average lux was determined. At zero mins, the pink glow stick gave off an average of 6.3 lux. After five mins, the pink glow stick gave off an average of 6.6 lux. After ten mins, the pink glow stick gave off an average of 4.3 lux. After 15 mins, the pink glow stick gave off an average of 3 lux. (See Figure 5)

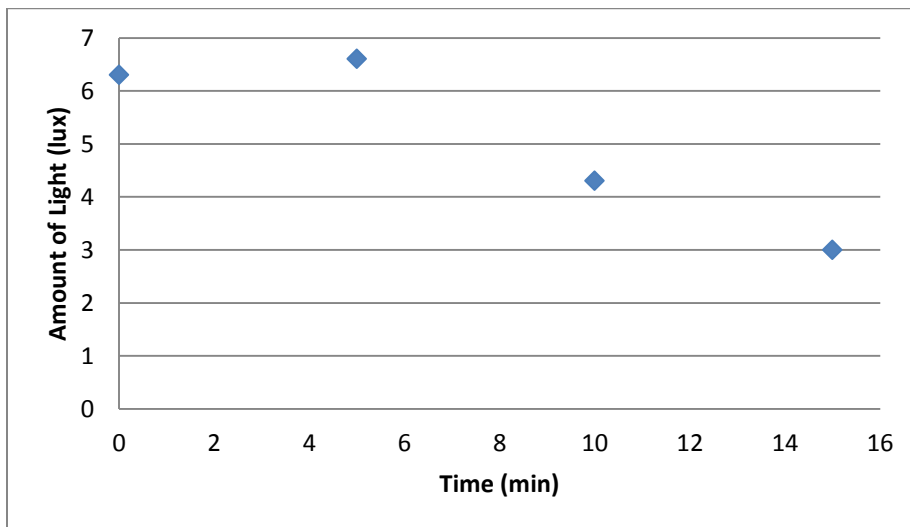


Figure 5: The Average Amount of Lux a Pink Glow Stick Gives Off After Five Minute Intervals

During the fifth experiment, the green glow stick's average lux was determined. At zero mins, the green glow stick gave off an average of 149.2 lux. After five mins, the green glow stick gave off an average of 62.23 lux. After ten mins, the green glow stick gave off an average of 46.7 lux. After fifteen mins, the green glow stick gave off an average of 37.06 lux. (See Figure 6)

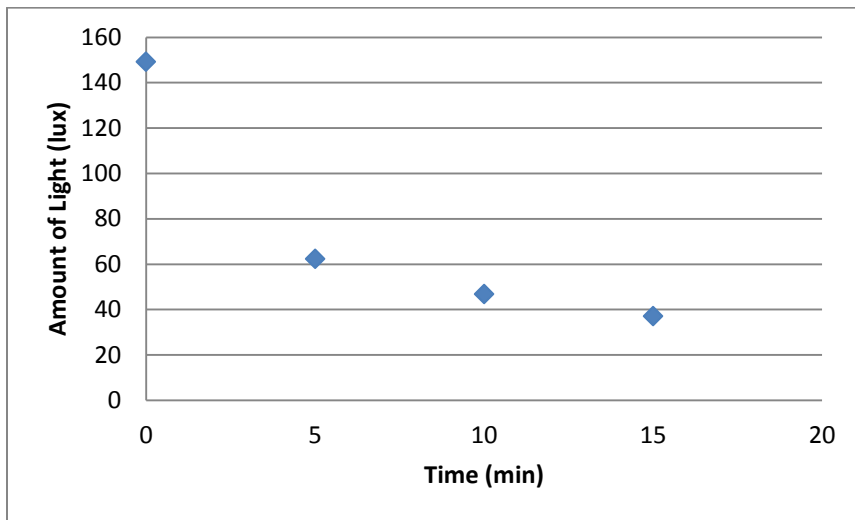


Figure 6: The Average Amount of Lux a Green Glow Stick Gives Off After Five Minute Intervals

CONCLUSION

In conclusion, it has been found that the green glow stick is the brightest but falls in third for longest lasting (light wise not time wise). The yellow glow stick falls in second for brightness but last for longest lasting. The orange glow stick falls in third for brightness but in second for longest lasting. For brightness, the pink glow stick is in last with its highest lux being 6.6. The pink glow stick is also the longest lasting glow stick. This experiment could be important to scuba divers when they are looking for a long lasting yet bright glow stick when they go diving in deep dark waters. The hypothesis was that the yellow glow stick would be the brightest due to the fact that it is the brightest out of the four colors (green, yellow, pink, orange). This hypothesis was proven wrong by the fact that green ended up being the brightest glow stick. For future follow-up experiments, it would be fun to figure out how much light other color glow sticks give off and to see if more glow sticks combined give off more light.

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