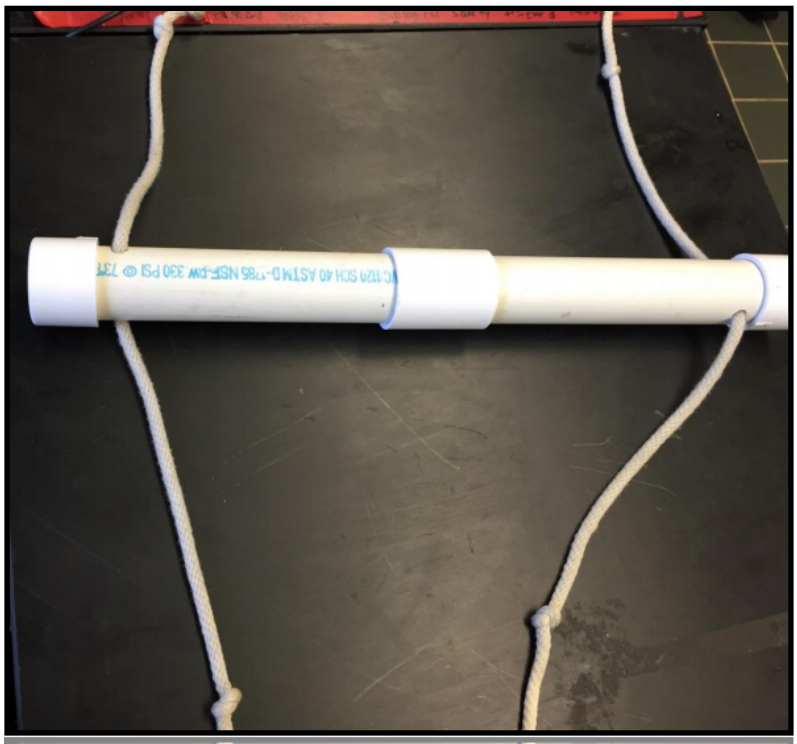
Learning the Scientific Method

Lab Report on analyzing the "Magic Tube"



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The Scientific Method

Introduction

The history of the scientific method dates back all the way to ancient Greece, in the thoughts of Leucippus and Democritus. But it really picked up in the European Renaissance with the likes Issac Newton and Galileo using the scientific method to aid them in their studies of gravity and astronomy. So for the first lab in the 10th grade Marine Biology Research Program, the task at hand was to explore the scientific method and look at the ways professional scientists use to solve their various hypotheses. In this lab, the goal was to be able to develop a hypothesis and then form theories about the engineering and possible mechanism that makes up a tube with a rope tugging property in it. The goal of the lab was to help show that science isn't always about seeing and is more about constant observations and tests, we as a society won't be able to accomplish some things and this lab introduced this concept. From not being able to look inside our own planet, to not knowing the position of electrons in any atom, all the way to only getting a sneak peak through telescopes of distant galaxies and then having to make hypotheses based on those pictures, we can't always be able to simply look at a problem.

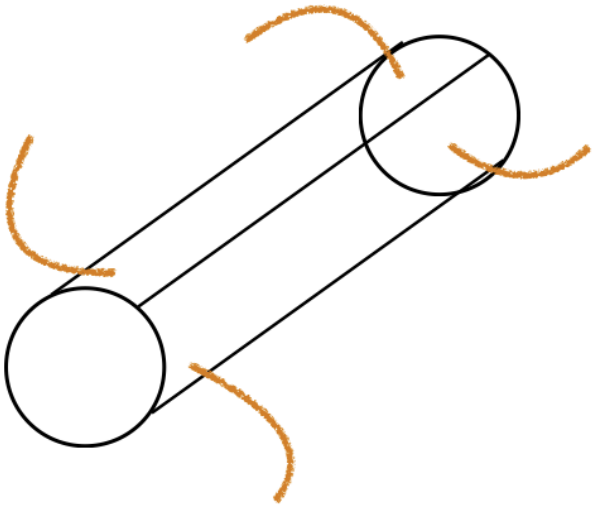
In this project the task was simple, use the scientific method to create a valid hypothesis that can be tested, and then test those hypotheses to form theories as to find out the mechanical component in the " Scientific Method Stick", which is really more a tube with four ropes sticking out of it. By studying this and learning from this task, patience and experience will be built up as to aid the professionalism of more in-depth research in the future.

Background

What is the scientific method? What is this wonderful tool used by scientists all of the world to conduct their research. The scientific method is the way a researcher circulates their ideas as to where they formulate hypothesize and then test those hypothesize, with the goal being an answer as to wether or not it supported or disproved one's question. And we use this tool everyday, Neil DeGrass Tyson once said, "A television advertisement must illustrate the scientific method to substantiate any claim.... That is why stains are lifted, ring-around-the-collar is removed, paper towels become soaked, excess stomach acid is absorbed, and headaches go away-all during the commercial." In this lab the goal was to think more like a researcher and use the scientific method to solve a task. And the task at hand was to discover what was the mechanical component of a piece of PVC piping with four ends of ropes coming out of the ends of it. When you pull one string, the other strings will be pulled in to the tube, and when you pulled any other string the same effect would occur for any other string. What was the machine that made this magic stick possible and how can we use the scientific method to find out?

Figure 1

Model of Scientific Method Tube



Design

Originally, after some observations were made, it was deduced that there was a metal mechanical bit in the center that was the source of the "magic". This was further shown by when the tube mechanism could break, showing that the ropes were held together by an object or objects and that they were pulled by it so the other ropes were pulled in when one rope was moved. The original hypothesis was based on early facts but fully explained the magic tube, it answered the question, " How does this machine work?" With the metal mechanism at the center and two ropes being connected at the center, the mechanism could only break if too much pressure was applied to the rope. By trying to discover the shape and engineering of the mechanical bit in the center, as well as wether or not it is only comprised of two ropes will help answer the question about how this machine works.

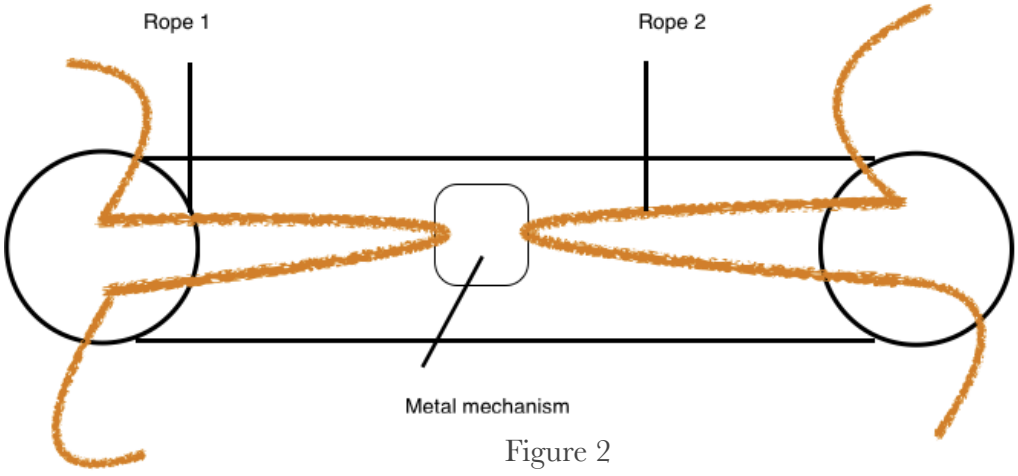


Figure 2

When one pulls on any end of any rope the other three ropes will move closer into the tube because when one pulls their rope they are pulling the mechanism connecting both ropes in towards the pulled one.

Materials

1) " Magic Tube" (PVC piping piece with seemingly magical properties, pull one rope in and the other ropes will pull in as if they are connected in some way). Quantity 1.

2) Magnet set with a medium guess, with the purpose of locating the bit and measuring it's size. Quantity 1.

3) Regular colored scotch masking tape to help mark and indicate specific ropes and give a better general understand as to how the machine works. Quantity 1 role.

4) Lab note sheet, for tracking and logging data. Quantity 1.

Procedures

How can using the scientific method of making observations, measurements, and models help us accurately depict what the mechanical component in the " magic tube" looks like?

Using the scientific method, the tube observations were made by using assorted tools such as magnet sets, colored masking tape, and data sheets to guide the lab. The magnet for discovering the positioning of the metal mechanical piece and making notes of it's size, the tape for labeling rope ends so that one could understand the machine better, and the lab packet for organizing data in a mindful way as to be simple to look back upon.

Three models were made in this process with a reflection being written for each one of them. Over time the hypothesizes grew enough evidence for new theories to be formed. Each time a hypothesis was modeled, a new tool was added. For example after the first hypothesis was made, with the mechanical model (note figure 2, page 4 for general model and lab report pictures

for more in depth depiction) being modeled as a grooved piece of metal that connects two ropes together, the magnet was added to help fine point measurements of size and shape.

Finally a conclusive reflection of the experience was written after the tube was opened and the "magic" was unveiled, with the purpose being of an on-the-spot conclusion before a more formal entry was written in the lab report (check chapter, " Conclusion").

Results, Experiment Results, and Data Analysis

At the end of the lab, the tube was opened. Though the purpose of the project was to learn how to make observations, hypothesizes, and then later theories about objects and structures that can't be seen and be simply looked at, the tube was opened to check the accuracy of the models. The model that was hypothesized was actually surprisingly close to the real thing though, check figures 3 and 4. While the size was very incorrect and off by inches, the mechanical design was surprisingly close to one another, with the final hypothesis model being roughly exactly same to the mechanical component of the "magic" tube. The mechanical component being two rings at the end of two ropes connected in the center of the tube by two "lego" like pieces, but never actually being connected to the PVC pipping in anyway. The only difference between the observed model and the actual mechanical piece was it's size and way that the pieces were connected. The observed model had a large connector pieces and small rings, while the actual thing had the quite the opposite; small connector pieces and larger, thicker rings and the pieces connected more like "lego" pieces do, with one piece being larger than the other and the smaller one fitting into it instead off the hypothesized prong connectors. While these

things still explained how the machine worked, and the way that these bits were connected could have really been observed with the available tools, the mistakes made were still huge in the sense that the size was off by inches! These mistakes could have been easily avoided if more time was spent on observations

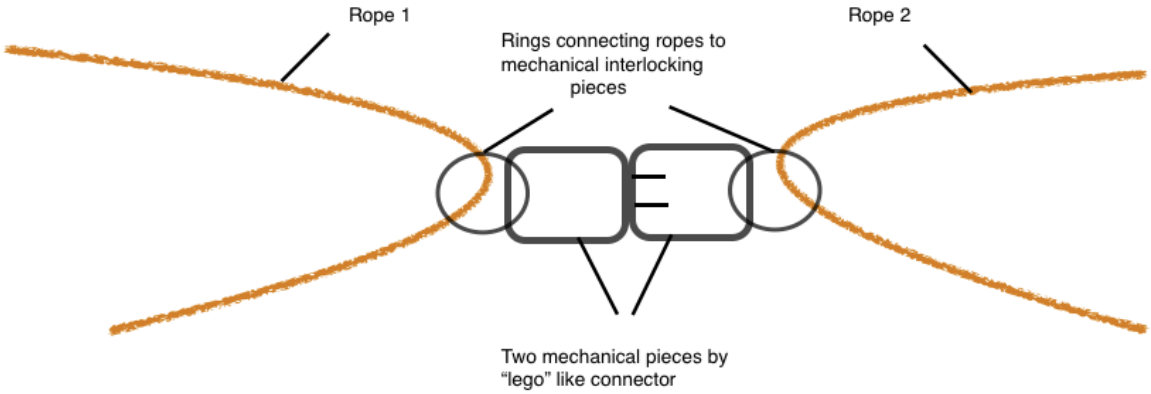


Figure 3 (up)

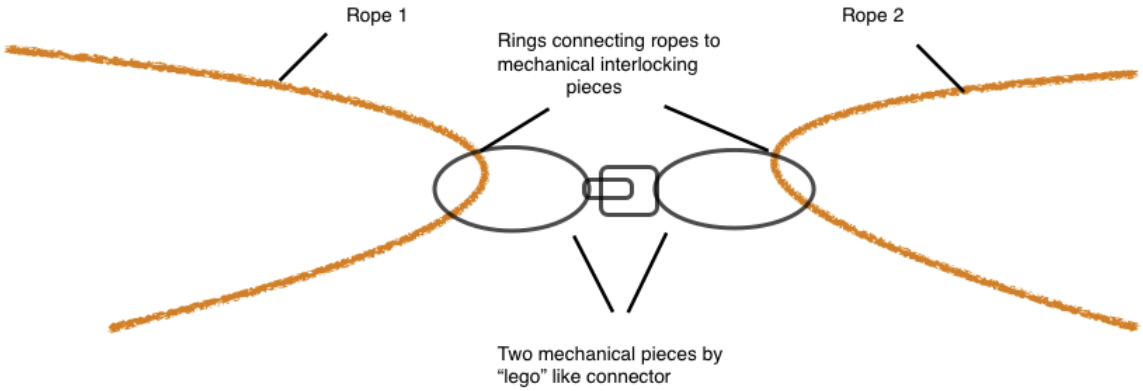
Hypothesis model

Rope is attached to a mechanical piece by two small rings, the mechanical pieces are held together by prongs that connect to one another.

Figure 4 (down)

Actual model

Rope is looped around a large ring, which connects the rope to a "lego" like mechanical connector (with a large piece having a smaller one fit into it).



Conclusion

In conclusion the hypothesis both rejected and supported the actuality of the " magic" tube's mechanical component. It did explain the occurrence of the machine, but any slightly thought out hypothesis would do the same, this hypothesis did have a little more evidence on it's supporting side though, boosting it to the class of a theory. Being that the stick had two enactors in the center, held together with prong like pieces that fit into one another, and those pieces being held to the rope with two small rings. But this theory was rejected, the mechanical part of the "magic" tube did not work as the prediction suggested. But it wasn't incredibly far off. With only a few sizing errors in it's truth and an incorrect way of depicting how the connecting method was used to hold the two ropes together, the theory was wrong in it of itself but held the general model of how the connecting pieces worked as well as the general outline of what the inside of the stick looked like. So in conclusion, the hypothesis was incorrect and was rejected by the lab results but wasn't far off, lacking only very small technical pieces. That being said though, those pieces, like size and exact way of connection, are incredibly important and this was an unnecessary error that could have been avoided if the magnet was used a little longer in attempts to locate the size of the mechanics more precisely.

In the future, if the lab was to be repeated, more time and effort should have been spent on the more technical aspects of the tube's features and less time spent on more general hypothesizes. More tools could have been used as well, because as we know many scientists have larger arsenals of tools at their disposal while this experiment had only a simple pack of magnets and masking tape. If this were to be repeated, by changing these aspects, the models could have been much more exact.

Figure 5

Page 1 of data recording sheet

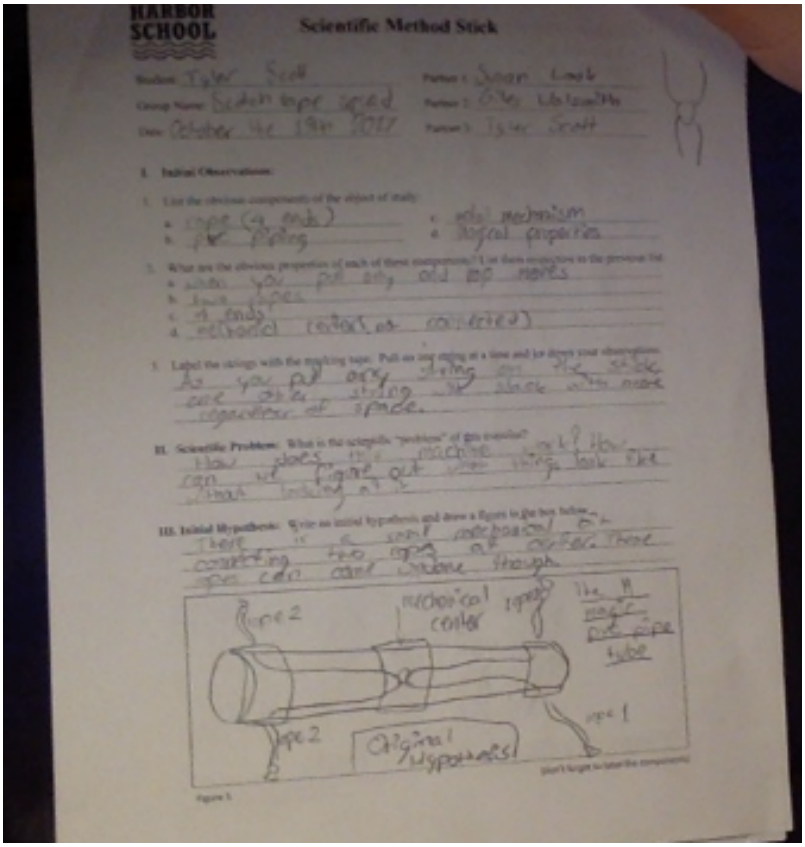


Figure 6

Page 2 of data recording sheet

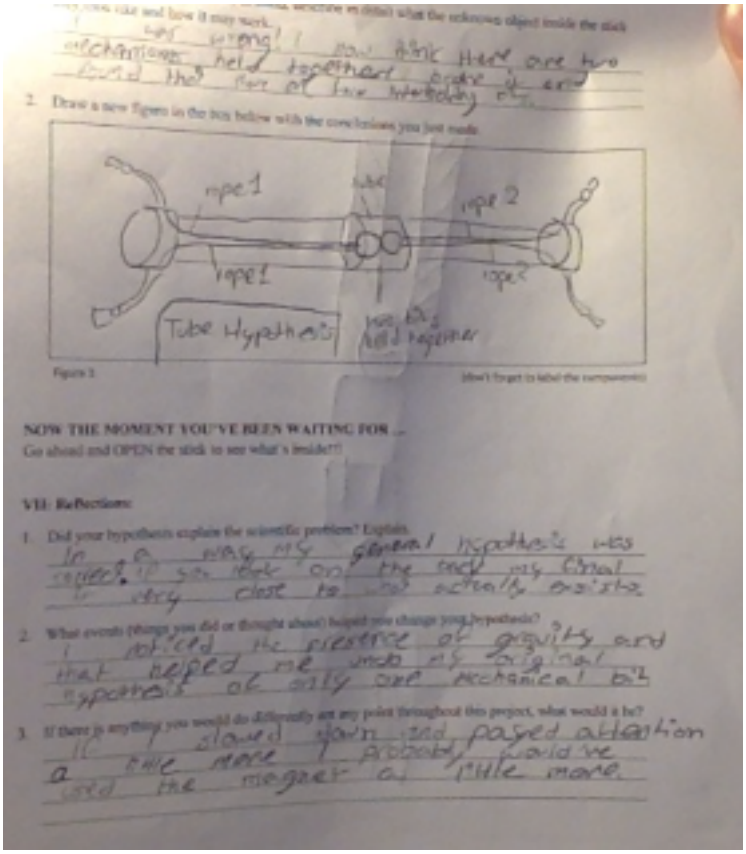


Figure 7

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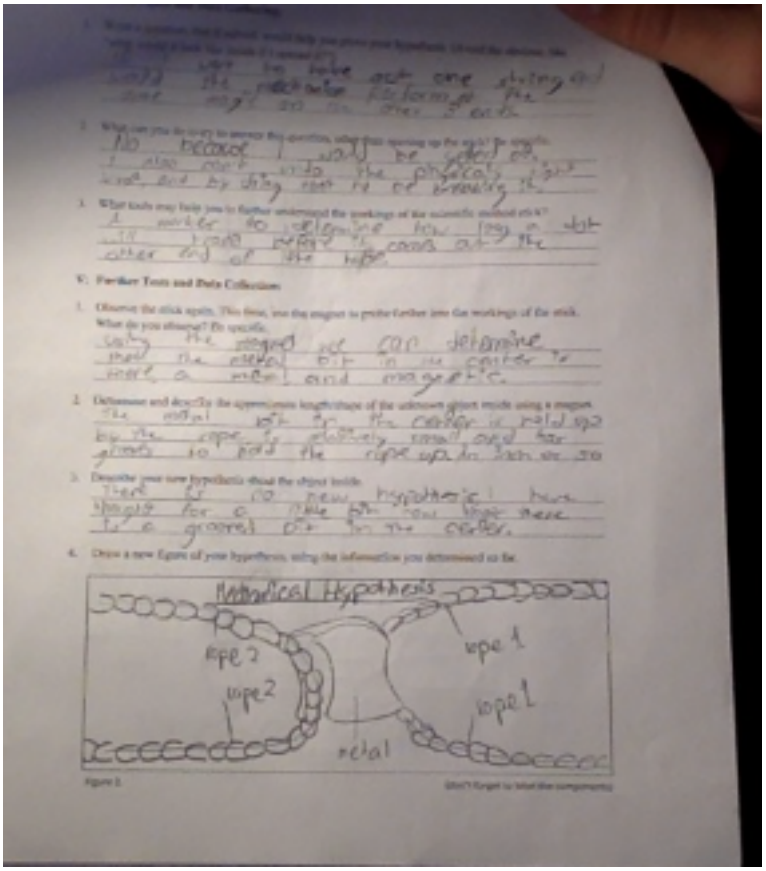

Figure 8

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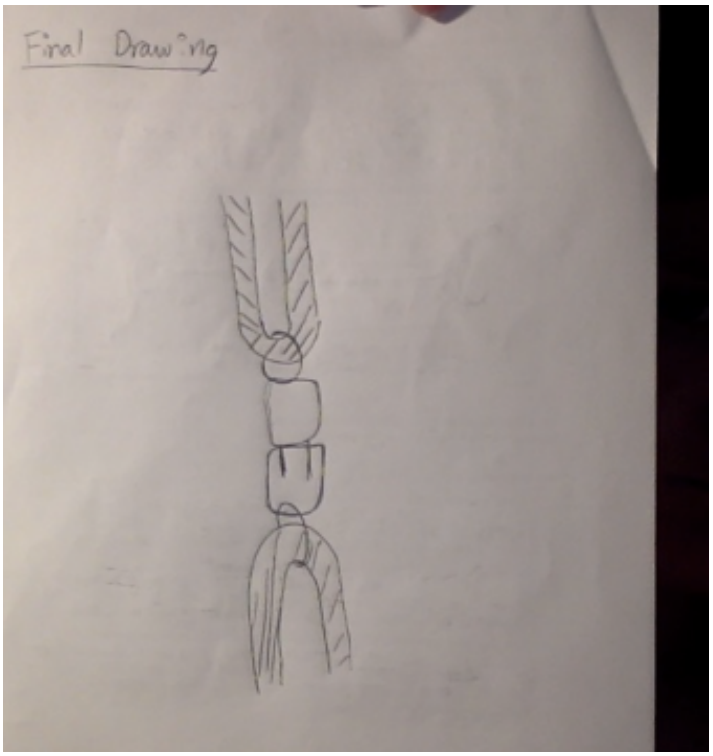

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Suggestions for improvement

While one cannot exactly extend this study because it was a practice lab with a clear answer, similar labs and more practice could help boost the skills learned in this one. The ideals of this lab are the fundamentals of the scientific method so by simply continuing to conduct research are we furthering the basis of this lab.