Yewno: A Real World Parabolic Expedition

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Abstract

Through determination and mind mapping, I was able to learn much about parabolas and how they're related to other mathematical concepts. Using Yewno Discover, I took six terms besides parabola and went into a deeper analysis of each term. The separate terms/concepts I chose were polynomials, quadratic form, circle, group theory and black hole. My last term was really a goal for me, it represented how I wanted to apply mathematical concepts to an idea separate from the mathematical world. I wanted to learn enough to identify the math in something separate from it. My paper will demonstrate these terms and how they're related to parabolas, enjoy!

Introduction

In this Algebra II course at Design Tech High, I explored the concept of parabolas from a Design Thinking perspective. Our instructor, Mr. Free used the Esther Wojcicki's Moonshot Thinking method by giving all students the Trust, Respect, Independence, Collaboration and Kindness (TRICK) to engage in a Real World Parabolic Expedition (Wojcicki, 2016). There were two parts to this process and the first part was a team exploration and inquiry were we ***learned through experiences*** by developing and implementing a mathematical design investigation with a focus on where parabolas are found in our designed world and we were to use ***content knowledge and skills to solving real world problems***. The second part was conducting research and creating knowledge maps that showed how other interdisciplinary concepts were connected to the quadratic equation or the parabola.

Throughout this unit, our instructor, gave us the freedom to go around campus and take images of parabolas and encouraged us to use investigative strategies and multiple approaches when exploring quadratic problems that came out throughout the inquiry **(design thinking to generate multiple solutions to complex problems).** We created several knowledge in action artifacts where in part 1, each team member Hanui, Helena, Jasmin and Casey examined our the parabola pictures to determined the structure of the parabola and determined the equation that modeled this structure. For the second part, each member had to come up with their own research question and conduct research on any area of interest. I used the Yewno Discovery platform to frame my inquiry and this research paper will show the knowledge maps and describe the connections that I discovered.

Part 1: Parabolas in Real Life with Design Algebra Collaboration Team

⇠ Hanui Lee

This necklace is an example of a parabola. The bicycle charm serves as the vertex of the parabola, as the weight (with the help of gravity) is what pulls the chain downward and creates the parabolic shape.

y=49/50x^2-2

Helena Shapiro ⇢

The crown has a parabolic shape in it's design because that is what a stereotypical crown looks like. The crown is symmetrical because it gives a more regal look.

y=13/40x^2-1.3

← Jasmin Texidor

It seems to me that the parabola was used in this instance because it offers the best support for a handle. It's the most convenient for this structure because it gives room for a hand to fit where the vertex is, but also has room for connecting the handle to the object that holds whatever needs to be transferred. Where x-intercepts would be, the handle meets the bucket and a parabola is the best option for a handle because it offers a space for the user's hand but also connects the handle to the bottom. The parabola used in this photo would have a negative "a" because it opens upwards, so it might be something like "y=-x^2".

Maybe parabola's are so common because they provide a sound structure as well as a hip with the jive style.

Casey Kiesling →

This hand truck handle is in the shape of a downwards opening parabola. This parabola is of the function $y = -(x)^2$. You can see the axis of symmetry, as it is where the pole in the back connects with the parabolic section of the handle. The handle was deliberately made in this parabola shape for multiple reasons. Firstly,

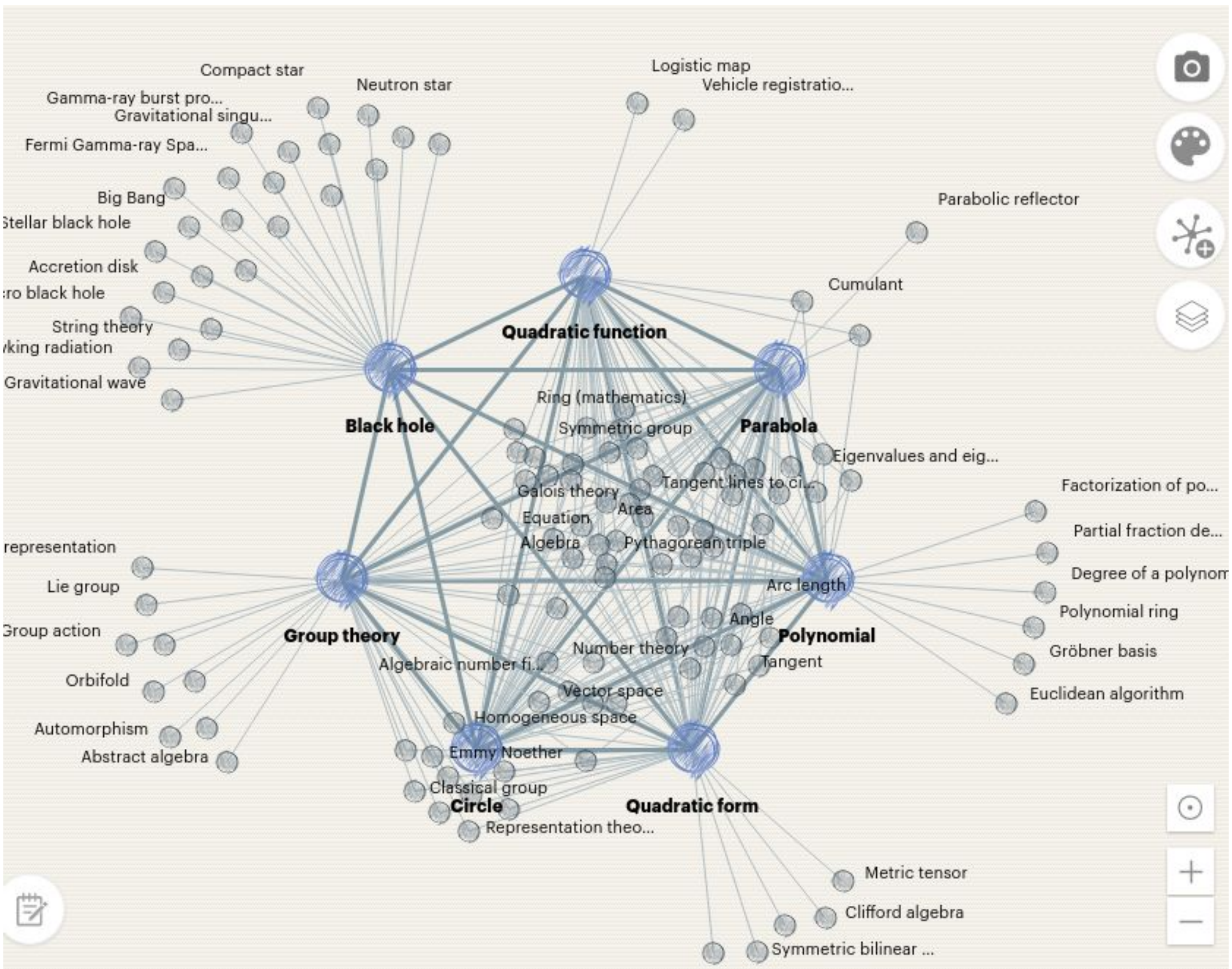
having the handle be symmetrical makes it easier to grip than having some off shape, unsymmetrical mess. In addition, the parabolic shape is far nicer to look at than other options, such as a square handle.

← Alexis Huang

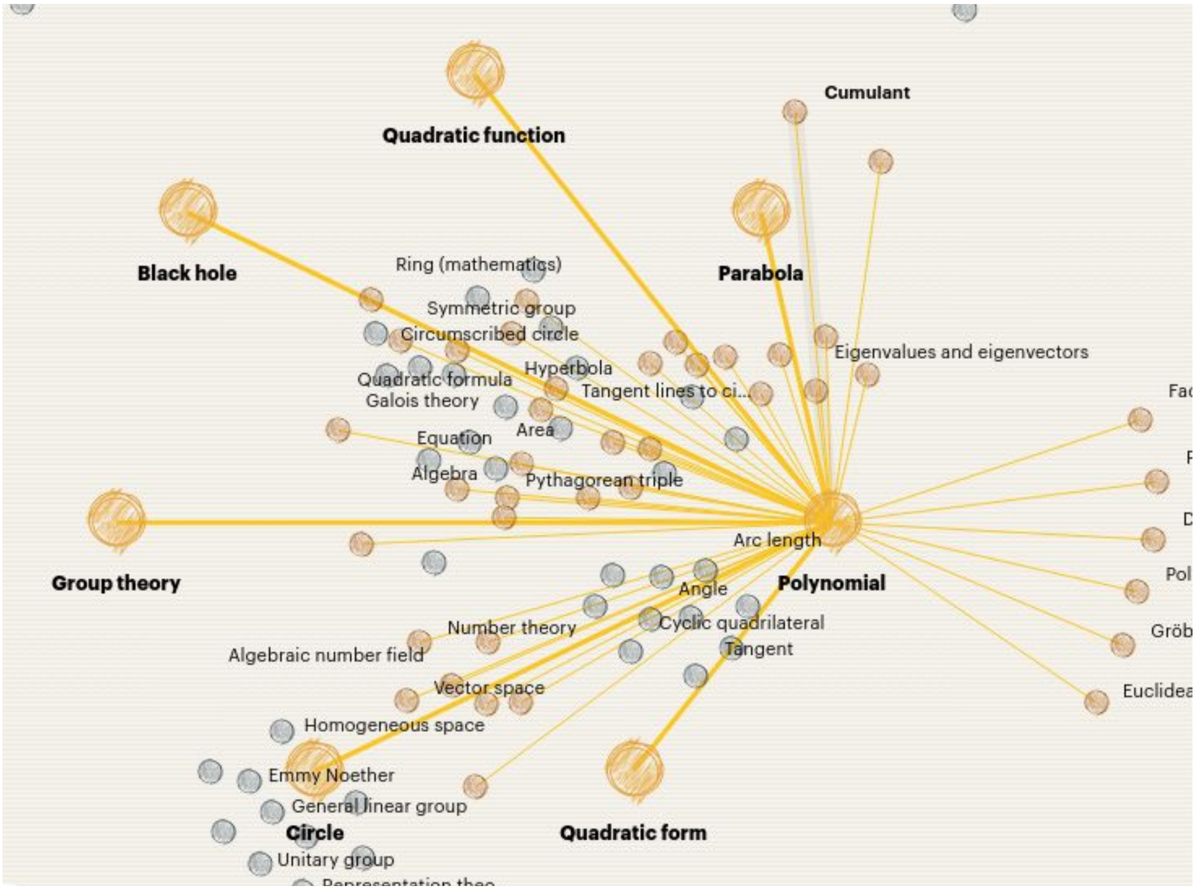
This chain hangs in the position of a parabola. This is a parabola of the function of y=x^2, since it opens upwards. This means that the “a” value of the equation would be positive. Like the necklace, this parabola is created due to gravity and the weight of the chain. The vertex of the parabola is where it hangs the lowest, and the closest towards the ground. Any piece of string, when suspended from two points (x intercepts) generally forms the shape of a parabola. For example, this chain, as shown in this picture, is supported at two main points. The midpoint between the two support areas is the x value for the vertex.

Part 2: Parabolas in Real Life Independent Research using Yewno Discover to generate personalized Knowledge Map

In this applied mathematics performance task, I used Yewno Discover, a new kind of visual knowledge search engine developed by Rugerro Grammatica (2017) for research and learning. This Artificial Intelligence Platform assists students and researchers spark new ideas and explore interdisciplinary fields to create better research output**.** After exploring concepts that I chose, I came up with an original and unique knowledge map that I used to gain a deeper understanding about parabolas and their relation to the world.



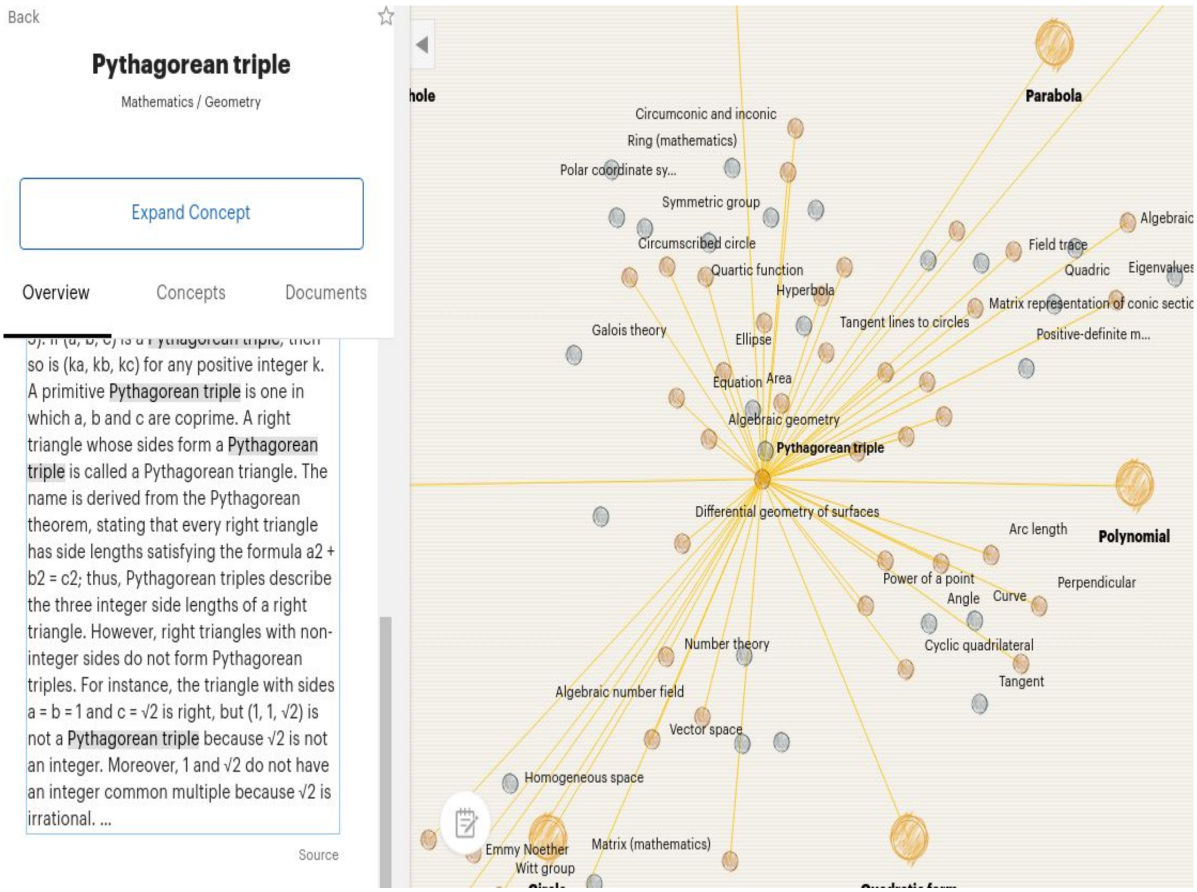
Polynomials



Connection ↴☐

I discovered that polynomials are connected to polynomial factorization, which is a process of expressing a polynomial as the product of a factor that has coefficients in the same domain. It's connected to parabolas because sometimes parabolas can be determined by an irreducible polynomial degree, usually when it's by a degree of 2.

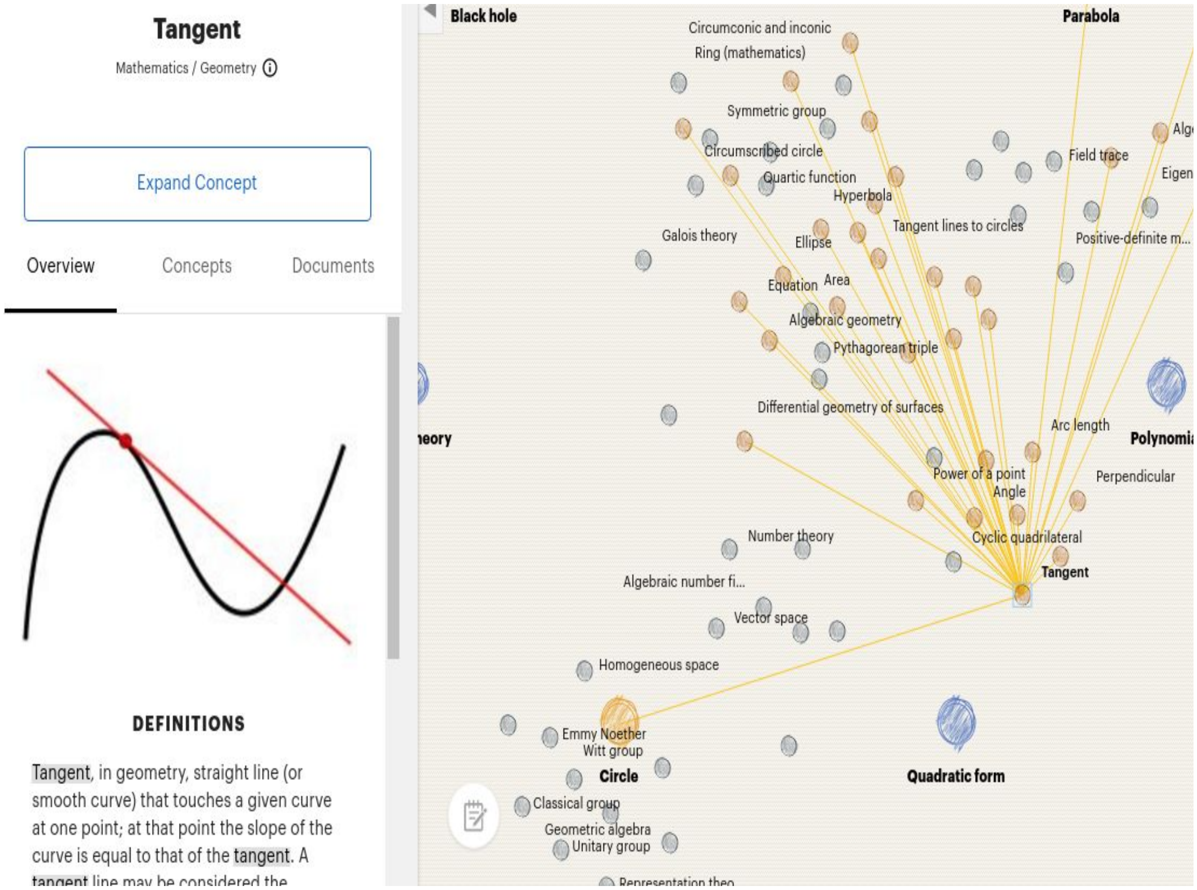
Quadratic Form



Connection ⤵

The third term I chose was the quadratic form. I saw that it was connected to the idea of a pythagorean triple, a term I've come across before in geometry. A pythagorean triple is something that consists of three integers. The set of integers is positive and they have to fit the formula(or rule) $a^2 + b^2 = c^2$. The quadratic formula is connected to parabolas because you can turn the quadratic formula into something that can be graphed. Quadratics are basically the basis of a parabola.

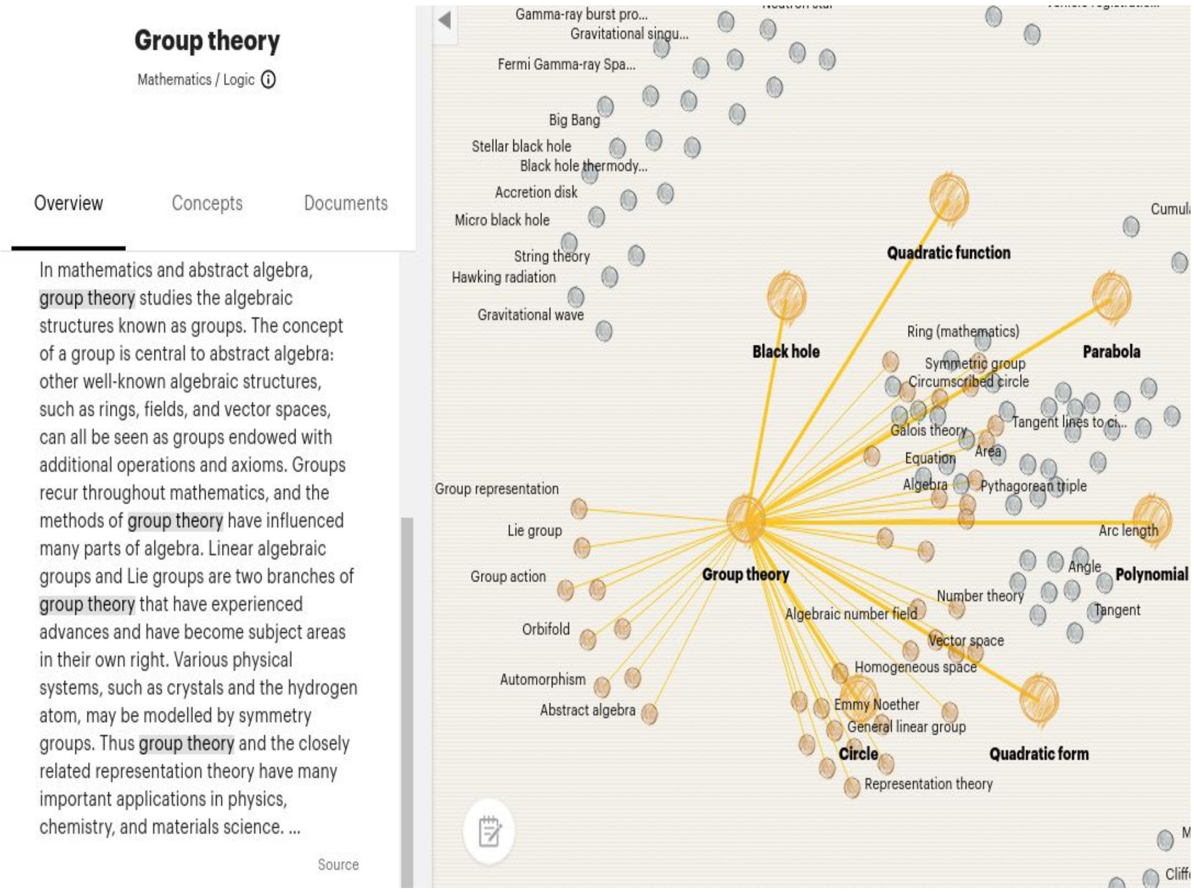
Circle



Connection ↴

The next concept I had on my mind map was a circle. Circles are of course a unique and interesting shape. It's area, circumference and angles can be determined in many ways, but there was one term I was interested in looking into further: tangent. Tangent is another geometry term that coincides with sine and cosine. Tangent can be a straight line or a smooth curve, and it touches a curve at one point. Circles are related to parabolas because if you manipulate the equation of a parabola enough you can form a circle.

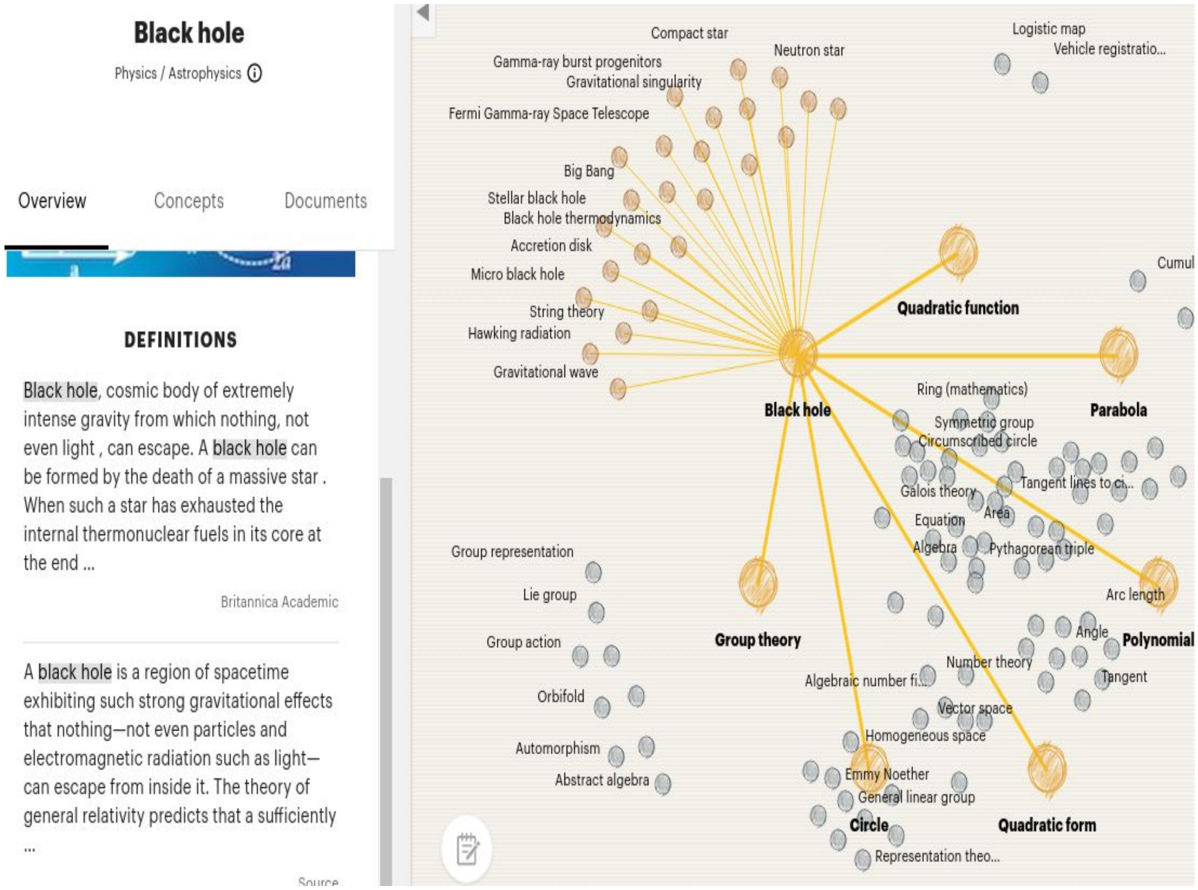
Group Theory



Connection ⤵

My next term is group theory, an algebraic study of the structures called groups. Abstract algebra revolves around the idea and study of groups. There are other well known structures like rings, fields, and vector spaces; these can all be classified as groups as well. Some structures included in group theory have become so large they're groups themselves and have an individual study dedicated to them. Now, group theory itself is related to parabolas because some of the characteristics of a parabola are groups themselves.

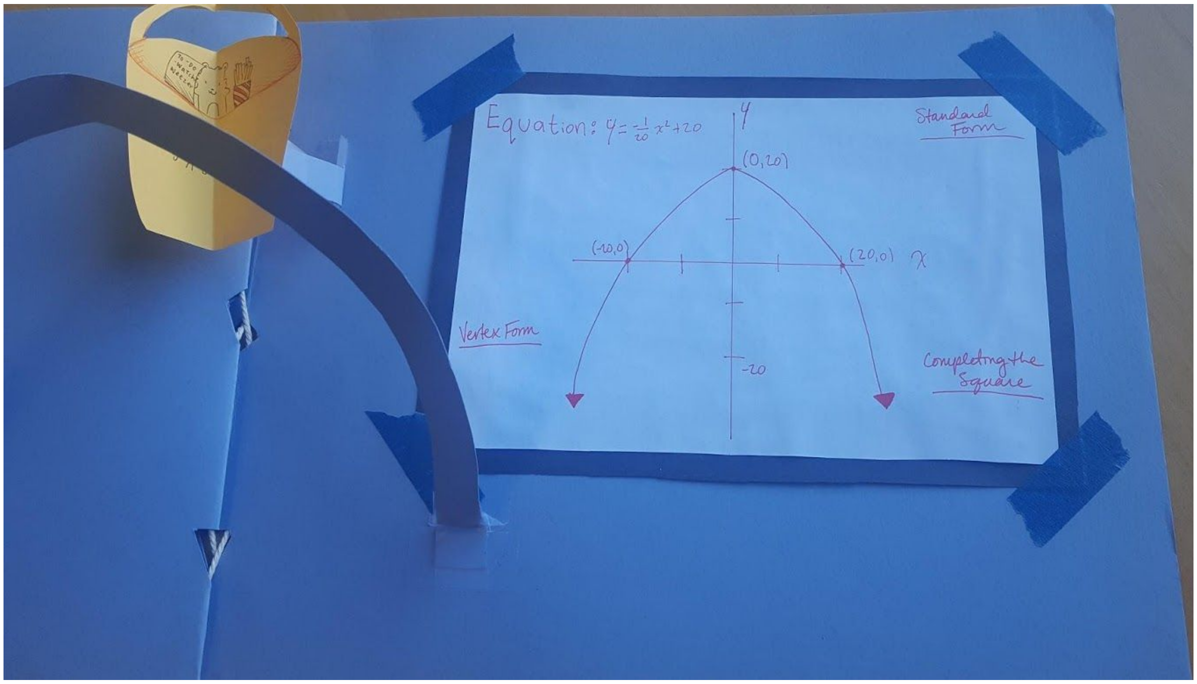
Black Hole



Connection ↴

The last term I decided to explore through Yewno Discover was black holes. So black holes aren't really a math term, but they're heavily reliant on math, I discovered that through deep research in this performance task.. Every term I was discovering actually related to black holes, which I anticipated but wanted to go a little deeper into. Black holes are of course very intense bodies of cosmic gravity that engulfs anything that comes near it. I guess parabolas are related to black holes because the formula for a parabola could correlate with some of the math needed to decipher how a black hole operate. It

Knowledge in Action: Multiple Representation



How does this all Relate?

After my Yewno Discovery exploration, I looked back at my previous design parabola project and found that quadratic equations directly relate to parabolas. To graph a parabola, the ***parent function*** $y = x^2$ is used. This function can obviously be manipulated by changing the parameters (a, h, k, b and c) and each change to the parent function changes the shape of the parabola. If a number is put in front of the ***"x squared term",*** the way the shape of the graph also changes. If the absolute value of the number is greater than one, the parabola will be a more narrow, steep graph. When the absolute value of the number is less than one and greater than zero, basically a proper fraction, the parabola will be wider. Whether or not there is a negative x squared coefficient also changes part of the parabola. A negative number indicates a downward opening graph, while a positive number will give a graph that opens up.

While I was exploring what a quadratic function was I discovered how greatly parabolas rely on quadratic equations or functions. Exploring circles also introduced me to the idea that parabolic equations can be manipulated to produce a different graph shape, like a circle. Quadratic equations are once again important when deciding the shape of a graph. That's a basic overview of what the Yewno exploration taught me and how it related back to our parabola project. I found the Yewno platform extremely valuable in mathematical explorations and it gave me the ability to work independently and the freedom to choose my research focus.

References

Gramatica, R. & Pickering, R., (2017). Start-up story: Yewno: an AI-driven path to a knowledge-based future. Insights. 30(2), pp.107–111. DOI:http://doi.org/10.1629/uksg.369

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