MATHEMATICS AND ENVIRONMENT

SUBMITTED BY: MANAN ROY CHOUDHURY

CLASS: 12 A

AISSCE ROLL NO:

UNDER THE SUPERVISION OF :-

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Class: 12

CERTIFICATE

This is to certify that the project entitled "Mathematics and Environment" is a bona fide recode carried out by Manan Roy Choudhury, Class: XII ,AISSCE Roll Number-
, under the guidance and supervision of Mrs. Anita Bhattacharya .

(ANITA BHATTACHARYA)

(LOPA CHATTERJEE)
Principal

(EXTERNAL EXAMINER)

ACKNOWLEDGEMENT

Apart from my efforts, the success of any project depends largely on the encouragement and guidelines of many others. I take this opportunity to express my gratitude to the people who have been instrumental in successful completion of this project. I would like to show my greatest appreciation to our teacher Mrs. Anita Bhattacharya. I can't say thank you enough for her tremendous support and motivation. Without her encouragement and guidance this project would not have materialized . The guidance an support received from all the members who contributed and who are contributing to this project ,was vital for the success of the project. I am grateful for their constant support . Last but not the least I wish to avail myself of this opportunity, express a sense of gratitude and love to my friends and my beloved parents for their manual support and strength.

By Manan Roy Choudhury

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Date:

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INTRODUCTION

"Mathematics is the language in which the written the world" by: Sir Isaac Newton.

"Cantor said, "God is a geometer". Jacobi changed this to, "God is a arithmetician." Then came Kronecker and fashioned the memorable expression, "God created the natural numbers, and all the rest is the work of man.

By: Felix Klein

We all think that Mathematics has no practical application, but we all are so wrong in that context.

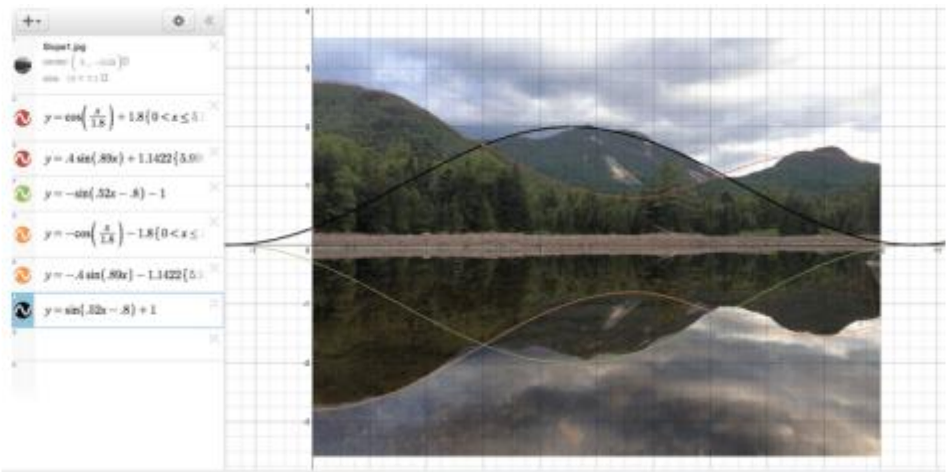
It is the language of God, one who truly loves the subject can experience the eternal truth of life.

<u>MATHEMATICS AND NATURE</u>

Using the derivative of a line to find the slope of a mountain at a certain point
While I was wandering through the interwebs looking for various ways math can be represented in nature, I came across a photograph that I found very intriguing.

Turns out this girl is a photography as well as math student, who is finding creative ways to combine her passions. The first thing I thought when I saw this photo was how cool it would be to do this with some of my own photos, knowing I have a lot of photos of the Adirondacks I figured it would be easy to find a picture of the local mountains to do this with, only lets take it up a notch, and find the slope of these mountains.

Using desmos we could play around to find the an equation that matched up pretty well with the mountains in this image.



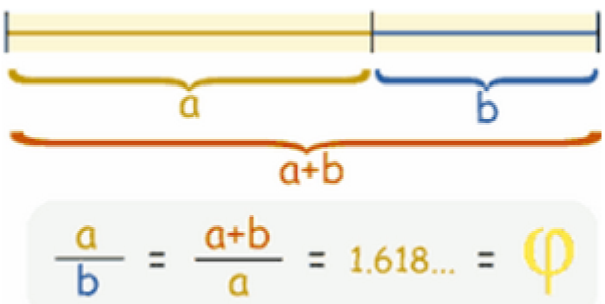
From here, it is not difficult to figure out the slope of any one of these mountains by using the derivatives of the equations we made.

Fibonacci in a Pine Cone

Ways the Golden Ratio is seen in Nature

We see math represented in nature more often than we think, and a biggy is the Golden Ratio. Most everyone has heard of the Fibonacci Sequence, but what really is the Golden Ratio?

Simply put it is when the ratio of two parts is equal to the ratio of both parts combined to the larger of the two, a visual often helps.



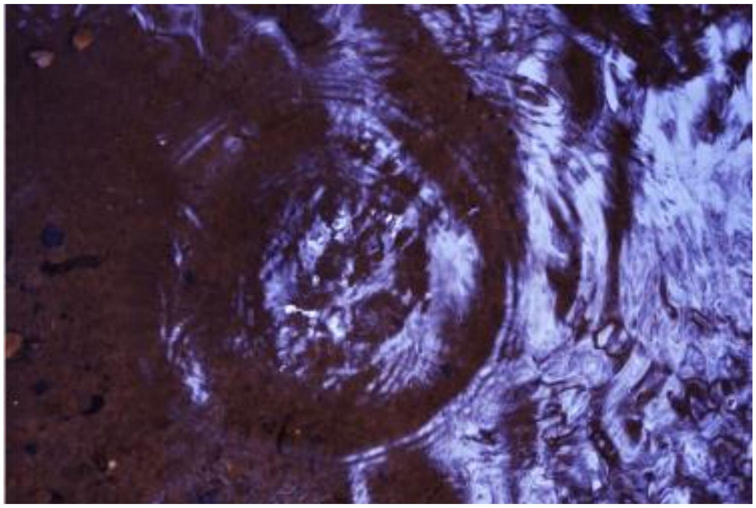
The Golden Ratio is seen everywhere from flowers, to hurricanes, to the proportions of the human body. One of the places it's seen in fibonacci spiral form is on pinecones. You can easily see the spirals going in one direction

but they go in another as well!

This is where Fibonacci numbers, which satisfy the Golden Ratio come into play. The amount of spirals in each of the two directions are a set of Fibonacci number.

Rates Ripples Grow

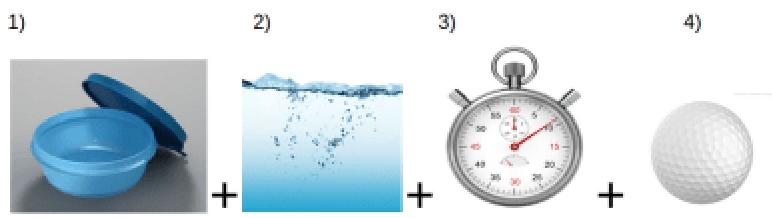
What really happens when you (or a fairly uniform flying projectile) make a splash



PRACTICAL UTILITIES

So, everybody loves making a splash. Literally. It's really fun to play with water, and it's everywhere in nature. One of the coolest things to watch is a stone skipping over water or a ripple spreading out from where a big stone just got spelunked. Why can't we use math to at least try to understand that process better?

So, we're going to use calculus to study ripples, but we decided to collect our own real life data first. There were four necessary ingredients to begin making mischief:



A uniform container with a fixed diameter

Water!!

A stopwatch

A fairly uniform flying projectile

(plus we needed a meterstick to get a measure of the container, but that's esoteria

Next we assumed that the rate at which the diameter grows is directly proportional to the length of the diameter itself at any given moment…

SO!

We dropped a ball from a constant height into the specific container at its center (or as close to the center as possible)

We measured the time it took for the initial ripple to reach the walls of the container

We took multiple trials

Diameter of projectile = 1.68 inches

Diameter of container – 10.875 inches

Trial 1	.43 seconds	
Trial 2	.48 seconds	
Trial 3	.55 seconds	
Trial 4	.58 seconds	
	Average:	.51 seconds

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Then, we tried to derive the equation for the rate and rate constant of ripples caused by golf balls at any specific time. Disclaimer!: We have assumed the rate at which the diameter of a ripple grows is directly proportional to the size of the diameter at any given moment theoretically. We haven't taken into account the rate at which the amplitude of each ripple decreases, making the ripple seem to diminish to nothing eventually. Theoretically, the diameter will continue to grow ad infinitum.

e^(12.6926(t))(1.68)=y

(For the diameter in inches)

P.S. — Remember that this is in inches. Don't try to use this equation for metric units!!

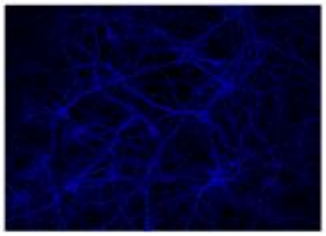
Moral of the story: Theoretically, things get enormous very quickly.

Fractals: THEY'RE EVERYWHERE!!!

Branching Fractals seen in Leaves

Soooooo…. You know how lightning leaves branching highlight impressions on your retinas when you look directly at it? Those patterns are distinctive, and though you can't necessarily distinguish the minutia between different lightning formations, they all seem to form a pretty generic branching shape. Sort of like how all river deltas seem to form triangular tributary shapes that appear the same from respective distances. Or how blood vessels seem as multifaceted and chaotic in a closeup as from far away. Get where I'm going with this? I'm talking about never ending patterns… Repetitions that are infinitely complex and self similar on different scales….A.K.A.

…..FRACTALS!!!!


Now, fractals aren't easy to write, and they lend themselves more to programming. Enter simple Rachel program…

Pretty neat, right?

So fractals can be contractive and iterant (approaching a certain point) or they can grow ad infinitum. For the sake of simplicity, we'll assume the fractals we are working with are iterant.

Sort of like galaxy fractals!

But I digress…

Don't worry though! Programming isn't the only way to represent fractal growth. There are several notations that tell an awesome fractal story including:

the Hutchinson system with a Hutchinson operator and attractor

$$\{f_i : X \to X | i = 1, 2, \ldots, N\},\ N \in \mathbb{N}$$

$$H(A) = \bigcup_{i=1}^{N} f_i(A).$$

This works only with contractile fractals

the Lindenmayer system

Example:

G = (*V*, ω, *P*) → V=elements that can be replaced, symbols from v describing initial state, P=production rules describing how variables can be replaced

Variables: F,G

Constants: +,-,[,]

Start: (F → F-[G+F]+[G-F])(G → GG)

Rules: F means "draw forward", − means "turn left 30°", and + means "turn right 30°". G does not correspond to any drawing action and is used to control the evolution of the curve.[corresponds to saving the current values for position and angle, which are restored when the corresponding] is executed.

Angle: 30°

BONUS!: It was originally designed to illustrate the growth and patterning in plants!!! PERFECT!!

CONCLUSION

Mathematics is present in every part of our life. It is present in every centimeter of our mother nature. It is omnipresent and omnipotent. God has really taken time to build this world and Mathematics has been its major tool. Just take deep breath and stare at the outside world, keep calm and quite, the world will tell you its secret of life.

REFERRENCES

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