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Eco-Mathematics – A study on Interpreting Nature with Mathematics

Dr.C.Inbam
Assistant Professor
Dept of Mathematics
Govt Arts College, Melur
Madurai Dt

Abstract

Math can be difficult at times. Nonetheless, we study ideas ranging from counting to algebra from childhood onwards. Even the most ardent opponents of mathematics cannot deny its significance. Everything we do in our daily lives and on our planet is governed by mathematics. People who work in fields unrelated to mathematics are required to apply basic math on a daily basis. The science of patterns and relationships is known as mathematics. It can be used in practically any discipline. Mathematics is present in every aspect of our existence. Mathematics is often quite theoretical in high school and even university, and it's difficult to comprehend how it's used in the actual world. Mathematics isn't particularly intriguing unless it's connected to other subjects, such as biology. Let us pique people's interest in mathematics by comprehending and demonstrating its real-world applicability. The focus of this paper is on beautiful mathematics in nature.

Keywords: Nature, Mathematics, Patterns.

1. Introduction

Nature is becoming more foreign as technology becomes increasingly visible in people's daily lives. People require nature in their lives to stoke their imaginations and create experiences that are not possible to obtain through any means of technology. Take, for example, Maths. It excludes pencil lines, chalk marks, physical triangles, and physical sets from consideration. It is concerned with concepts that can be represented by physical objects. It also teaches precision in thought and speech. There is hardly any aspect of life that is unaffected by mathematics. What's more intriguing is the fact that mathematics and nature are inextricably linked. Rainbows, river meanders, and shadows, as well as animal skins, spider webs, and honeycombs, abound in the visible world.The visible world is replete of patterns that may be explained mathematically, from rainbows, river meanders, and shadows to animal skins, spider webs, and honeycombs.

At various levels and scales, mathematics can explain natural patterns. Natural selection and sexual selection are biological processes that explain patterns in living things. Computer models are used in pattern creation studies to replicate a wide range of patterns. Mathematics is the foundation of the natural world and can be seen in a variety of ways. Here are a handful of my favorite instances of mathematics in nature, although there are plenty more.

2. The Fibonacci Series

This numerical sequence is a simple yet meaningful pattern named after the great mathematician Leonardo Fibonacci.

This series starts with the numbers 1 and 1, and each successive number is discovered by adding the two preceding numbers, according to Fibonacci's "rabbit problem." As a result, the next number following 1 and 1 is 2 (1+1). The following numbers are 3 (1+2), 5 (2+3), and so on. The numbers in the sequence are frequently encountered in nature, which is amazing.

GerdAltmann photographed the Fibonacci Spiral. Take note of a seashell's spiral. It begins with an 11 square, followed by another 11 square, a 21 square, a 32 square, and so on.

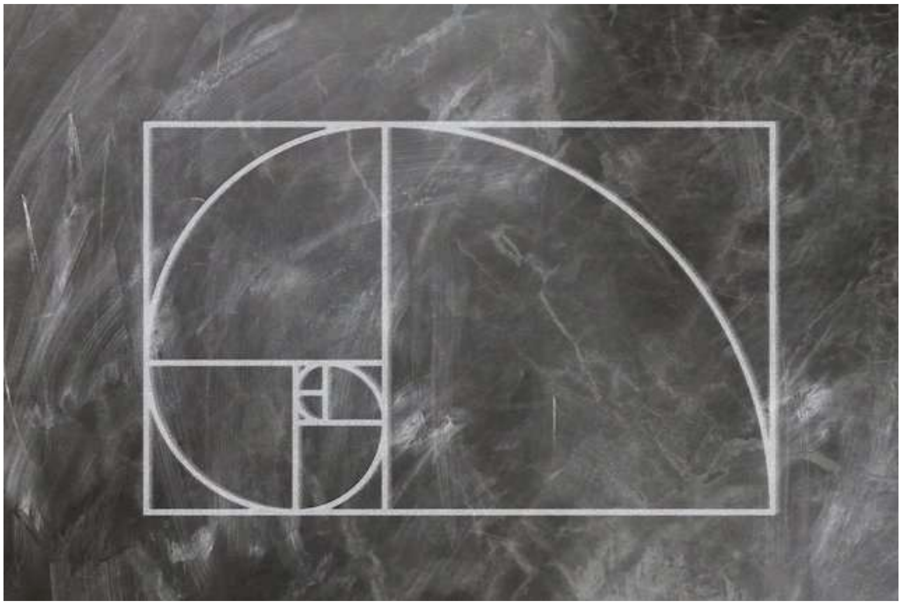

Figure 1. Fibonacci Spiral

A few examples include the number of spirals:

1. Pine cone
2. Pineapple
3. Seeds in a sunflower
4. Number of petals on a flower

Figure 2. No of Spirals - Petals on a Flower

The numbers in this series also create a Fibonacci spiral, which can be seen in nature in the form of shells and hurricanes.In our cosmos, there is a mathematical order. Let's begin with the rivers. We can determine the sinuosity or bendiness of a river by measuring its length and dividing it by the direct route from beginning to end. The average sinuosity of every river on the planet is pi, according to mathematicians.

Sinuosity = l / d

Where,

l→ Length of the River

d→ Distance of the River

The same mathematical constant that is used to compute an electron's mass and a baby's delicate breathing is used to determine how bendy all rivers are. Its digits never end and never repeat themselves, but they cannot be random because they represent the inherent order of things in nature.

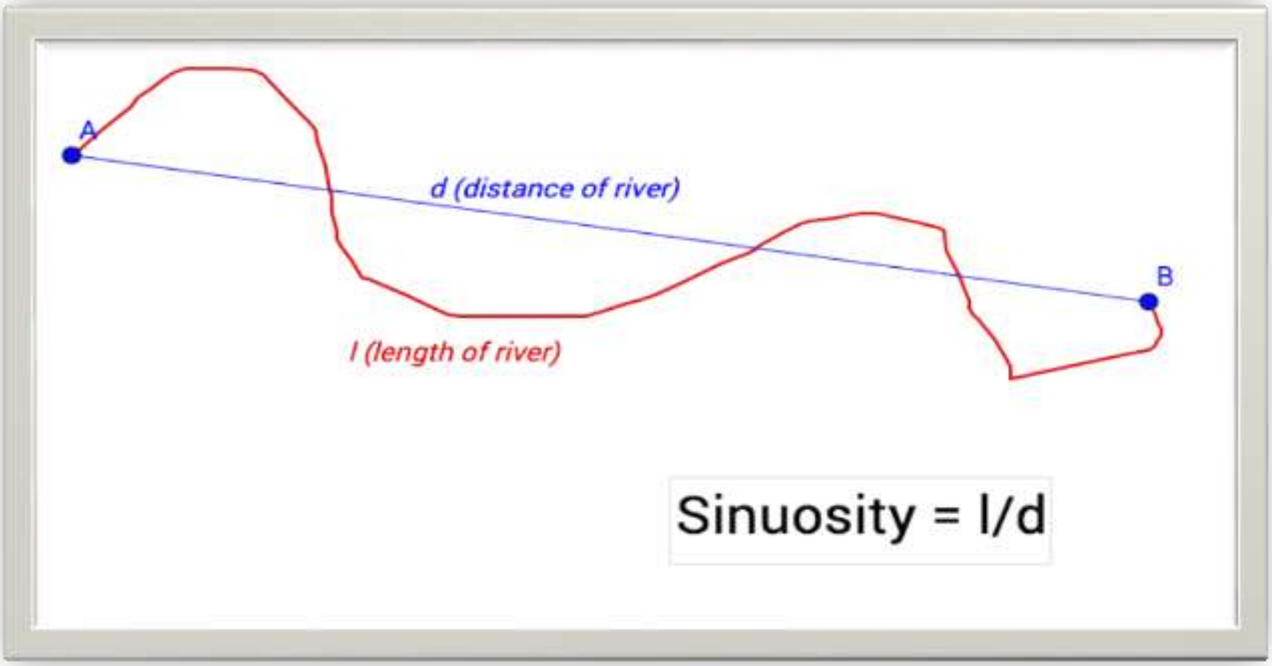

Figure 3. Sinuosity or Bendiness of a River

3. Nature's Geometric Marvels

The hexagon is another one of nature's geometric marvels. A regular hexagon has six equal-length sides, and this shape can be found all over the world. A bee hive is the most common example of hexagons in nature.

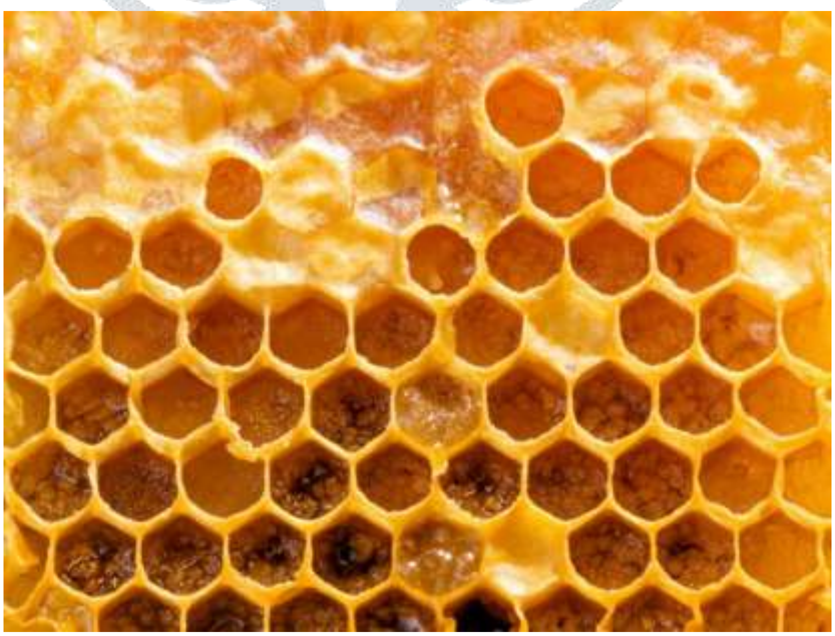

Figure 3. Bee Hive – Hexagon

3.1.Mathematics in Outer Space

As we go away from Earth, many of these same mathematical features can be seen in outer space. Our galaxy, for example, has a Fibonacci spiral shape. The planets orbit the sun in concentric circles. Saturn's rings are also made up of concentric circles. The symmetry between the earth, moon, and sun, which allows for a solar eclipse, is the only symmetry in outer space that is unique (as far as science can tell). Every two years, as it moves between the sun and the earth, the moon appears to completely obscure the sun.The moon is so smaller than the sun.

Despite being 400 times smaller than the sun, the moon is 400 times farther away. This symmetry allows for a total solar eclipse, something no other planet appears to have. The order of the cosmos can be deduced from the patterns that occur in the universe.

Figure 4. Galaxy – Fibonacci Spiral

Even the appearance of randomness in the shape of a tree's branches has order. The main trunk of a tree will continue to grow until it forms a branch with two growth sites, and each stem will split into two. Every new stem follows a similar pattern.

Figure 5. Tree Branches

This mathematical sequence applies to mammals as well. In order to determine whether or not anything is alive, we inject it with some kind of life-giving substance. The only difference between a live and a dead bird is revealed by the pattern of its molecules. It is also used to determine its condition. Many birds use celestial objects like the Sun or stars to direct their flight trajectories that demand certain trigonometric calculations. However, they are not actively calculating these things. Animals simply do what they are capable of.A heavenly gift that had been given to them for millions of years had helped them develop the skills they needed to survive. For example:

1. Birds solve a trigonometry problem
2. Waterfall solves the Navier-Stokes equation
3. Dog uses visual and chemical information to locate an object

Figure 7. Birds - Flight Trajectories

4. Applications of Wisdom from Nature

Two interesting optimization techniques that have taken birth from what is seen in the nature are:

1. Ant Colony Optimization (ACO)
2. Artificial Bee Colony Algorithm (ABC)

ACO is a probabilistic method for resolving issues that can be reduced to finding good pathways through graphs. In the natural world, ants (at first) leave pheromone trails while travelling aimlessly, then return to their colony once they have found food. If additional ants come across such a path, they will follow it. The pheromone trail, on the other hand, begins to fade over time, lowering the attractiveness of the pheromone. The longer it takes an ant to walk down and back up the trail, the longer the pheromones have to evaporate.

Shorter pathways have a higher pheromone density than longer ones. Evaporation of pheromones also has the benefit of avoiding convergence to a locally optimal solution. As a result, when one ant discovers a favorable (i.e., short) way from the colony to a food supply, other ants are more inclined to follow it, and positive feedback eventually leads to all ants following the same path. It has revolutionized urban transportation systems and many other fields that require the computation of the shortest path to a goal. The following figure shows the pheromone trail as follows:

A: Ants in Pheromone trail from food to nest.
B: An obstacle interrupts the trail.
C: Ants find two paths to go around the obstacle

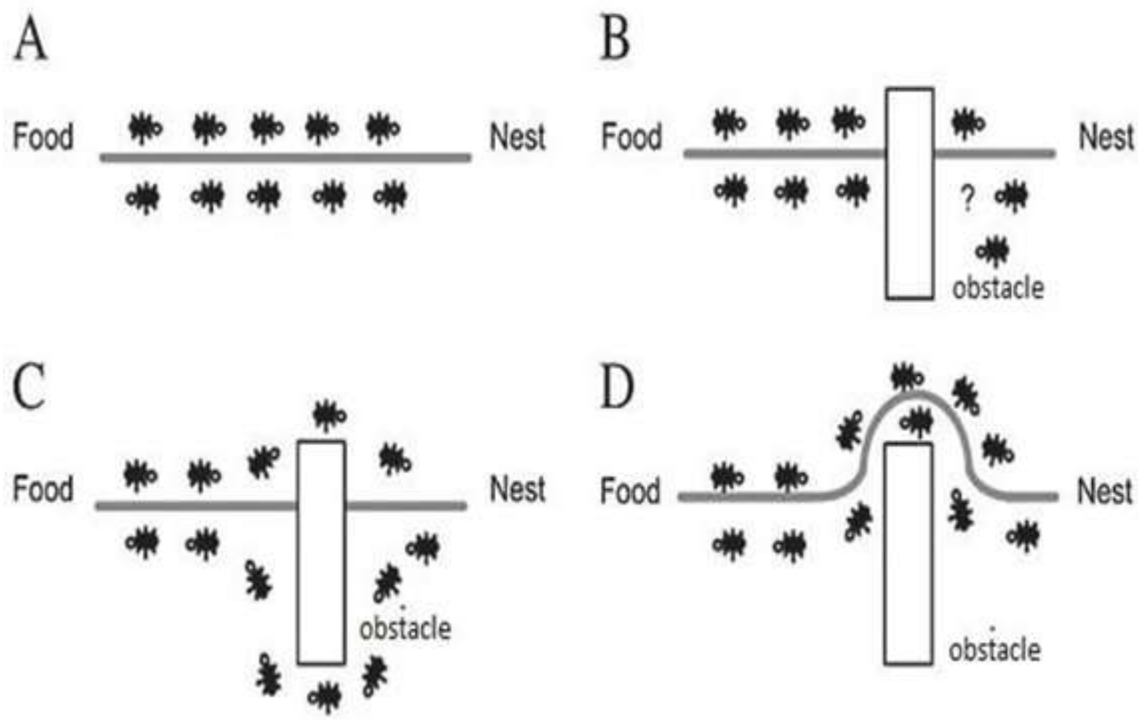

Figure 8. Ant Colony Optimization (ACO)

Karaboga presented ABC, an optimization method based on the intelligent foraging behaviour of honey bee swarms, in 2005. In general, bees choose a small portion of the colony to forage for food on a regular basis (they are called scout bees). When these scout bees identify a highly profitable food supply, they proceed to the "dance floor" in the hive and execute a ritual known as "the waggle dance." The length of the dance is related to the food source's scout rating. The other bees join the scout bee in exploiting the flower patch after observing this dance. This method allows bees to quickly shift their foraging efforts to the most valuable floral patches.

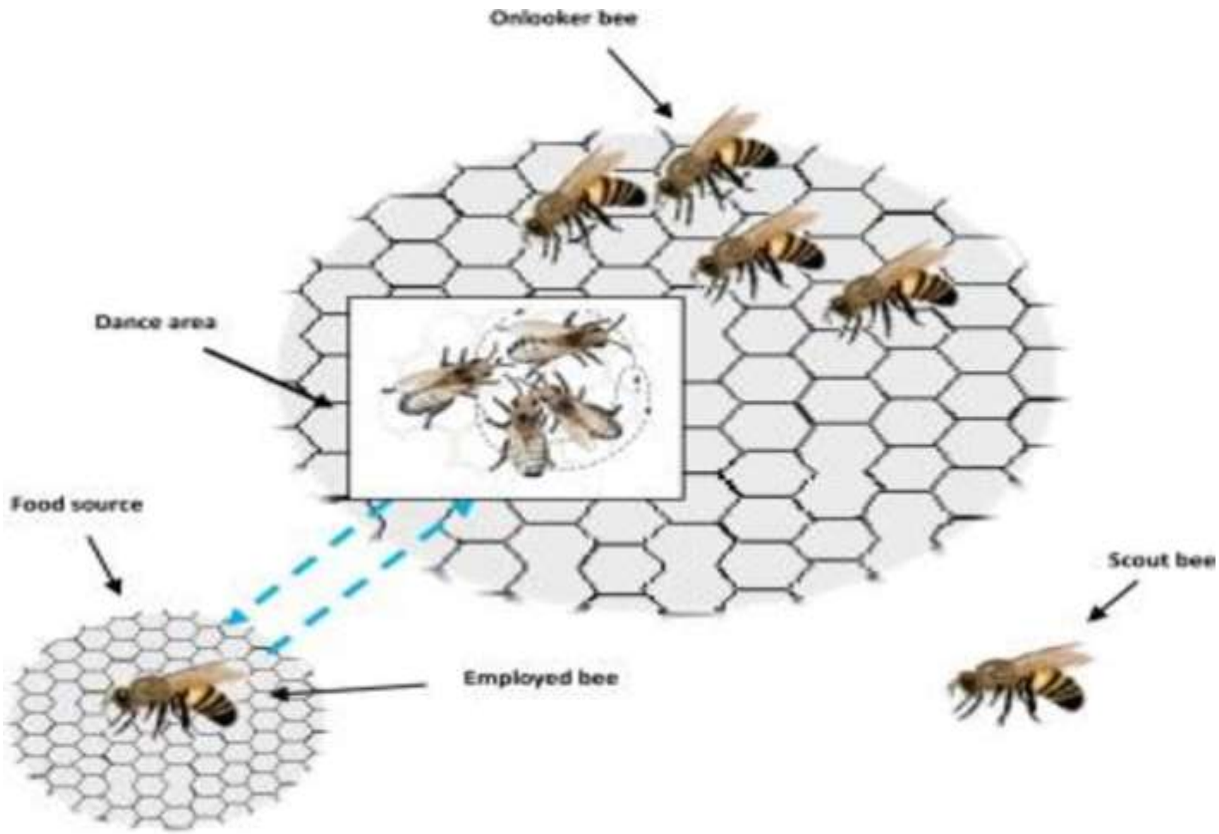

Figure 9. Artificial Bee Colony Algorithm (ABC)

The ABC algorithm uses a similar approach: all solutions are examined initially, then solutions that are no longer useful are discarded, and fresh solutions are supplied to enable the investigation of new regions in the search space. ABC is used to solve problems in numerical optimization, clustering, neural network training, and image processing.

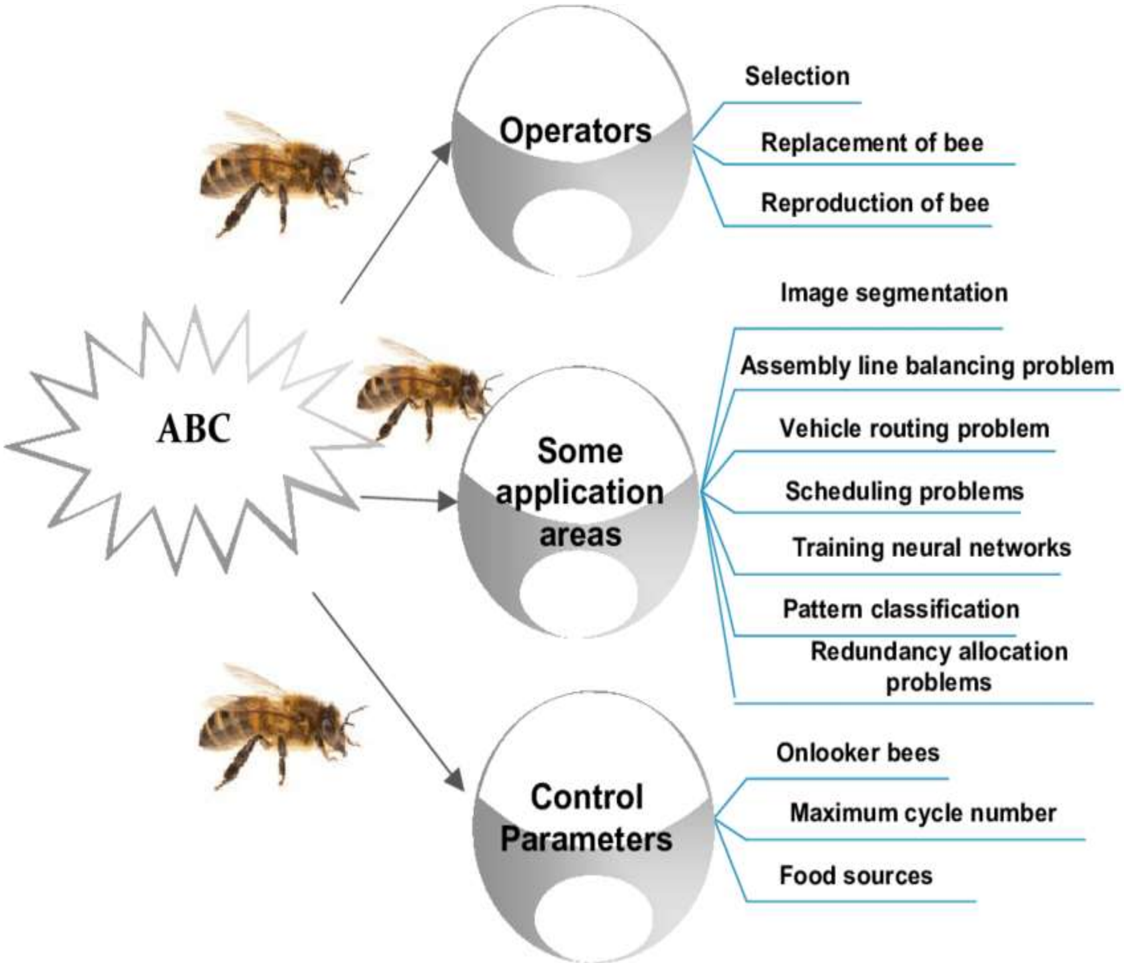

Figure 10. Applications of ABC

5. Conclusion

Mathematics is merely a tool for interpreting all of this activity. So, can arithmetic also assist us comprehend how our own brains function? Can we put a number on how it feels to meet someone special for the first time, or how it feels to spend time with them? Consciousness can be thought of as a mathematical pattern. When information is processed according to a set of patterns, such as those seen in tree branches or the fluid dynamics of a cascade, the sensation is called consciousness.

Many of these perplexing issues have remedies in nature. Many of nature's wonders may be traced back to mathematics, from the flight pattern of birds employed in aviation studies to the croak pattern of frogs. One notion leads to another, which leads to another, and so on! Nature and mathematics, on the whole, are domains that approach to infinity; both are monarchs of their own kingdom.

It is a lovely emergent phenomenon that only occurs when molecules are placed in a specific pattern, similar to how wetness only occurs when water molecules are arranged in a specific way. We may utilize the beauty that surrounds us as our light on this journey since mathematics gives us a framework to reason about what the order underlying these patterns could be. One thing we keep up with and believe in, it might just lead us to the truth.

REFERENCES

1. Consecrating Science: Wonder, Knowledge, and the Natural World by Lisa H. Sideris. University of California Press, Berkeley, CA, U.S.A., 2017. 296 pp. Paper. ISBN: 978-0520294998.
2. A. Ione, Innovation and Visualization: Trajectories, Strategies, and Myths (Consciousness, Literature and the Arts 1) (Amsterdam: Rodopi, 2005).
3. Seeing: How Light Tells Us About the World by Tom Cornsweet. University of California Press, Berkeley, California, U.S.A., 2017. 200 pp., illus. ISBN: 978- 0520294639.
4. Edith Doove, Review of Textures of the Anthropocene: Grain Vapor Ray (November 2017): www.leonardo.info/review/2017/11/ review-of-textures-of-the-anthropocene -grain-vapor-ray. Also in Leonardo 51, No. 5, 535–536 (2018).
5. www.internationalgothic.group.shef .ac.uk/cfp-monsters-and-monstrosity-in -nineteenth-century-anglophone-litera ture (2017).
6. https://phys.org/news/2020-05-mystique-mathematics-beautiful-math-phenomena.html
7. Dorland Mountain Arts Colony, Residents: 2018: www.dorlandartscolony.com/ residents–2018.html