SHIVAJI UNIVERSITY, KOLHAPUR

VIVEKANAND COLLEGE, KOLHAPUR

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A
PROJECT
ON
ENTITELED

"MATHEMATICS IN NATURE"

BY

Mr. Akash Baburao Khamkar

UNDER THE GUIDANCE OF

Mr. S. P. Patankar
(HOD Department of Mathematics)

ROLL NUMBER: 7880

SEAT NUMBER: 7880

VIVEKANAND COLLEGE, KOLHAPUR

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DEPARTMENT OF MATHEMATICS

CERTIFICATE

This is certified that Mr. Akash Baburao Khamkar has satisfactorily completed required project entitled

"A BRIEF STUDY OF MATHEMATICS IN NATURE"

According to prescribed syllabus by Viekanand College, Kolhapur under "Shivaji University, Kolhapur", for B.Sc. III course in Mathematics under my supervision during the academic year 2021 -22

Date: 28/05/2022

Examiner **Project In Charge** **Head of Department**

HEAD
Department of Mathematics
Vivekanand College, Kolhapur

A

Project Report on

"MATHEMATICS IN NATURE"

Submitted to

DEPARTMENT OF MATHEMATICS

VIVEKANAND COLLEGE, KOLHAPUR

Submitted by

Mr. Akash Baburao Khamkar

Under the guidance of

Prof. S.P. Patankar

Prof. S.P. Thorat

Through

Principal,

Dr. R.R. Kumbhar

(Vivekanand College, Kolhapur)

For the Academic year **2021-22**

ACKNOWLEDGEMENT

We greatly thankful to Principal Dr. R.R. Kumbhar Sir for giving opportunity to conduct a study on this very important mathematical issue.

We are also thankful to Prof. S.P. Patankar, Head of Mathematics Department for their kind co-operation in completing this project work.

We wish to express our deep since of gratitude to our project guides Mr. S. P. Thorat sir, for their help and ever encouraging guidance in our project work.

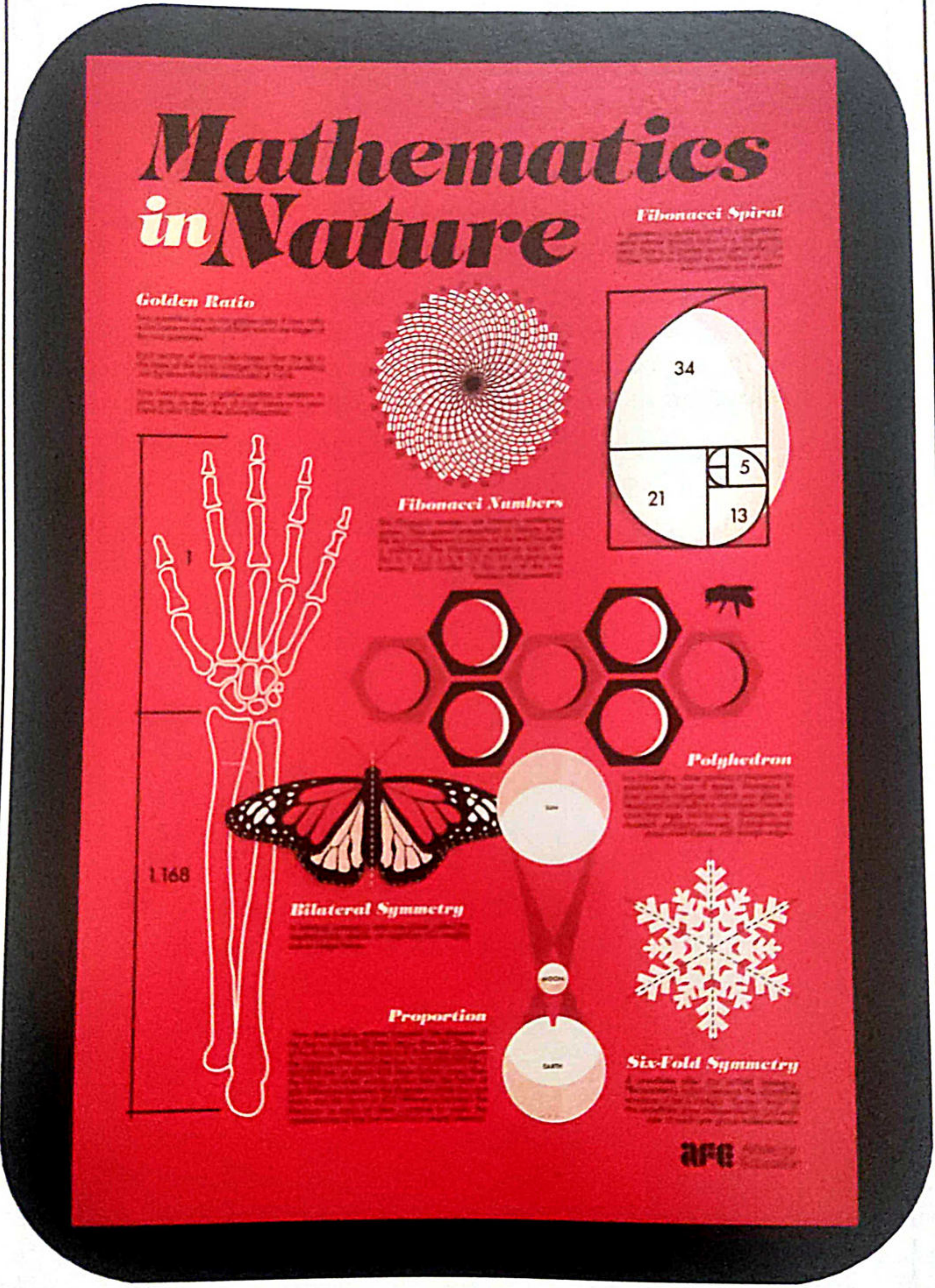
Finally, we would like to thanks to persons who directly or indirectly in several ways for completion of this project report.

Place: Kolhapur

Date: 28/05/2022

A.B.Khamkar.

Name of the Student and Signature
(Mr. Akash Baburao Khamkar)



Mathematics in Nature
Fibonacci Spiral
Golden Ratio
34
5
21
13
Fibonacci Numbers
1
Polyhedron
1.168
Bilateral Symmetry
MOON
Proportion
EARTH
Six-Fold Symmetry

PREFACE

It gives me immense pleasure in presenting this project We study the whole work of "**Mathematics in nature**".

The majority of our knowledge of mathematics and modern science is strictly based and supported on our observations of our environment. What was once seen as the randomness of nature is now distinguished as the intricate applications of mathematics and illustrates the complexities of our nature world.

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INTRODUCTION

For more than two thousand years. Mathematics has been a part of the human search for understanding. Today, mathematics as mode of thought and expression is more valuable than ever before. Learning to think in mathematical terms is an essential part of becoming a liberally educated person. Mathematics defined as the science which deals with logic with shape, quantity and arrangement. During ancient times in Egypt, the Egyptians used math's and complex mathematics equations like geometry and algebra. That is how they managed to build the pyramids.

Mathematics is all around us. As we discover more and more about our environment and our surrounding, we see that nature can be described mathematically. The beauty of a flower, the majesty of tree. even the rocks upon which we walk can exhibit natures sense of symmetry. Although there are other examples to be found in crystallography or even at a microscopic level of nature.

MATHEMATICS OF NATURE

When math is witnessed in its purest from the realization can be truly amazing. Sometimes the application of mathematics can seen to be separate from the natural world but in actual fact when we take the time, math can be seen all around us. As teachers we will always have to the answer the question 'why'; by providing tangible and authentic examples of math we can empower our student with knowledge and hopefully encourage a low for mathematics that is relevant to their daily lives. But how can we find examples of math in nature? It is as simple as opening our eyes. What was once seen as the randomness of nature is now distinguished as the intricate the complexities of our natural world. This web log is dedicated to just a few examples of nature's mathematics phenomena such as the

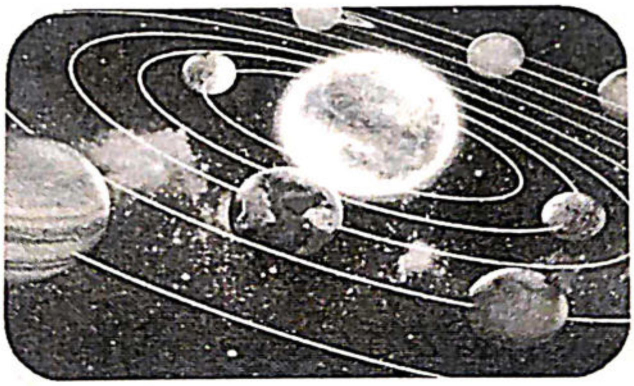
- Geometrical shapes
- Symmetry
- Fibonacci spiral
- The golden ratio
- Fractals

GEOMETRICAL SHAPE

❖ Spheres:

- Earth is the perfect shape for minimizing the pull of gravity on its outer edges – a sphere (although centrifugal force from its spin actually makes it an oblate spheroid, flattened at top and bottom). Geometry is the branch of mathematics that describes such shape.

Moving away from planet earth, we can also see many of the mathematical features in outer space.



- Sun and moon said to be circular when we see them for the earth. The planets orbit the sun on paths that are concentric. We also see concentric circles in the rings of Saturn.

But we also see a unique symmetry in outer space that is unique (as far as scientists can tell) and that is the symmetry between the earth, moon and sun that makes a solar eclipse possible.

Every two years, the moon passes between the sun and the earth in such a way that it appears to completely cover the sun. But how is this possible when the moon is so much smaller than the sun?

Because of math.

You see, the moon is approximately 400 times smaller than the sun, but it is also approximately 400 times further away.

This symmetry allows for a total solar eclipse that doesn't seem to happen on any other planet.

- An object is spherically symmetrical if it can be cut into two equal halves - regardless of the direction of the cut, as long as it passes through its center. Fruits like oranges and some lemons have a shape that is very close to being spherical.

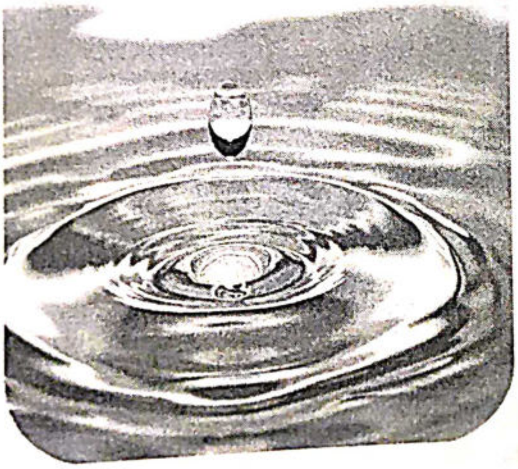
- **Concentric Circles in Nature:**

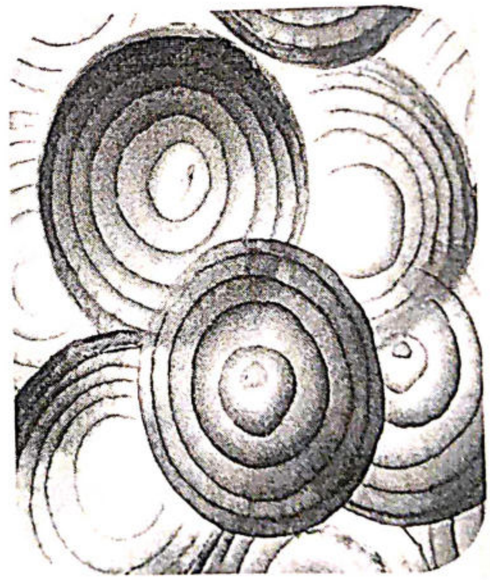
Another common shape in nature is a set of concentric circles. Concentric means the circles all share the same center, but have different radii. This means the circles are all different sizes, one inside the other.

A common example is in the ripples of a pond when something hits the surface of the water. But we also see concentric circles in the layers of an onion and the rings of trees that form as it grows and ages.

If you live near woods, you might go looking for a fallen tree to count the rings, or look for an or b spider web, which is built with

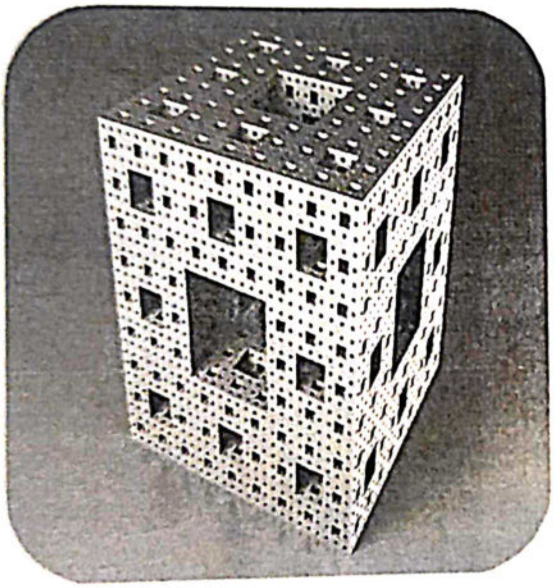
nearly perfect concentric circles.

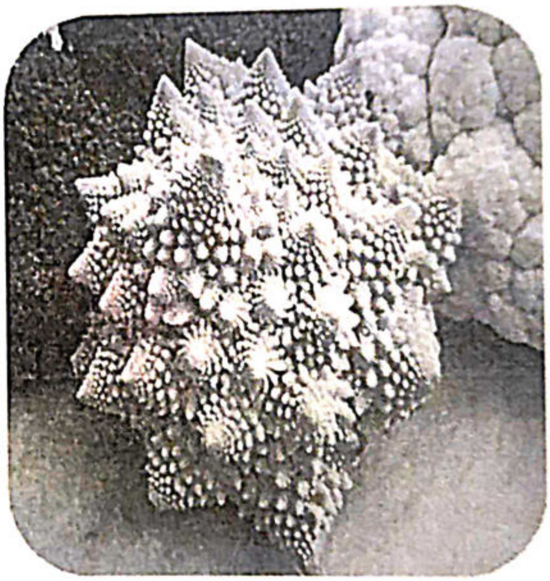


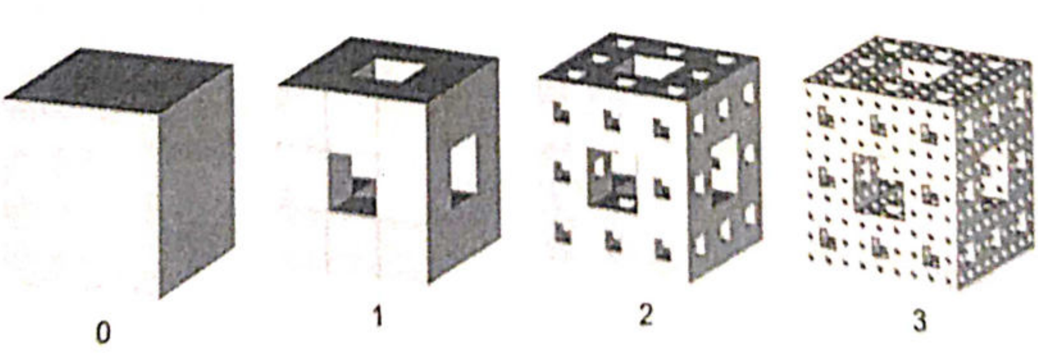


❖ Breakable Shapes:

- "Fractal", a term coined by the French mathematician Benoît Mandelbrot in the mid-1970s, comes from the Latin word "fractus", or "broken". This explains the logic of a fractal's geometry: it is a structure with a symmetrical scale. Any part of a fractal, no matter how small, has the same shape as the whole figure. A good example is the cube you see, better known as Menger's Sponge. The figure is named in honor of the Austrian mathematician Karl Menger, who in the last century studied the topology of geometric objects.



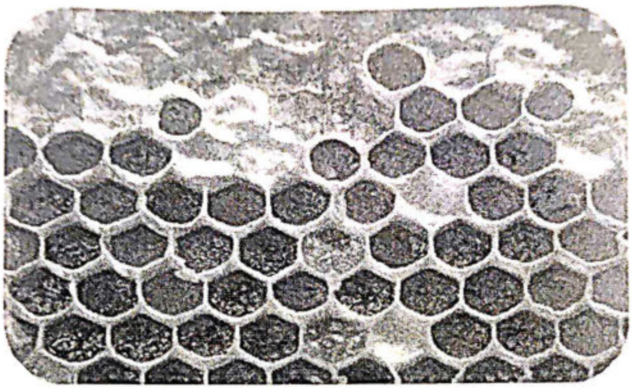




❖ Shape – Polyhedral:

- Another of nature's geometric wonders is the hexagon. A regular hexagon has 6 sides of equal length, and this shape is seen again and again in the world around us.

The most common example of nature using hexagons is in a been hive.



Bees build their hive using a tessellation of hexagons. But did you know that every snowflake is also in the shape of a hexagon?

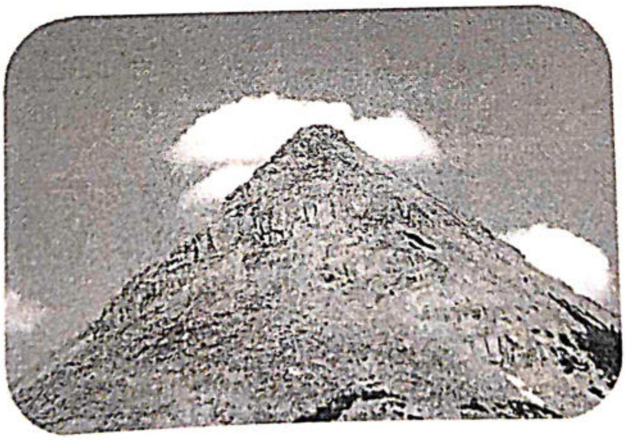
For a beehive, close packing is important to maximize use of space. Hexagons fit most closely together without any gaps. So hexagonal wax calls are what bees create to store their eggs and larvae. Hexagons are six sides polygons, closed, 2-dimentional, many- sided figures with straight edges.

We also see hexagons in the bubbles that make up a raft bubble. Although we usually think of bubbles as round, when many bubbles get pushed together on the surface of water, they take the shape of hexagons.

We also see hexagons in the bubbles that make up a raft bubble. Although we usually think of bubbles as round, when many bubbles get pushed together on the surface of water, they take the shape of hexagons.

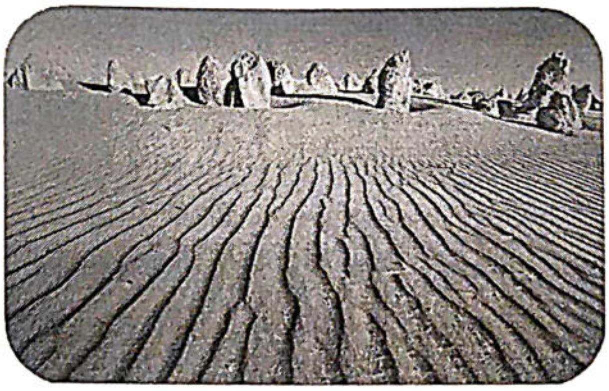
❖ Shape - Cones

- Volcanoes forms cones, the steepness and height of which depends on the runniness (viscosity)of the lava. Fast, runny lava forms flatter cones; thick viscous lava forms steep-sides cone. Cons are 3-dimentional solids whose volume can be calculated by 1/3 x are of base x height.



❖ Parallel line:

- In mathematics, parallel lines stretch to infinity, neither converging nor diverging. These parallel lines in the Australian desert aren't perfect- the physical world rarely is.



SYMMETRY

- Symmetry is everywhere you look in nature. Symmetry is when a figure has two sides that are mirror images of one another. It would be possible to draw a line through a picture of the object and along either side the image would look exactly the same. This line would be called a line symmetry.

There are two kind symmetries:

- Bilateral symmetry
- Radial symmetry

◆ Bilateral symmetry:

One is **Bilateral symmetry** in which an object has two sides that are mirror images of which other.

The human body would be an excellent example of a living being that has **Bilateral symmetry.**

The **bilateral symmetry**, also called sagittal plane symmetry, is that condition of a structure according to which it is divided into two equal halves. They are usually left and right halves and are mirror images of each other (like reflection in a mirror).

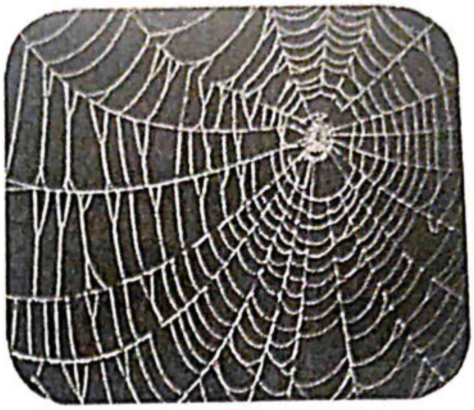
Fractals are another intriguing mathematical shape that we seen in nature. A fractal is a self-similar, repeating shape, meaning the same basic shape is seen again and again in the shape itself.

In other words, if you were to zoom way in or zoom way out, the same shape is seen throughout.

◆ Radial symmetry

The other kind of symmetry is Radial symmetry. This is where there is a center point and numerous lines of symmetry could be drown.

Radial symmetry is a rotational symmetry around a fixed point known as the center. Radial symmetry can be classified as either cyclic or dihedral. Cyclic symmetries are represented with the notation Cn, where n is the number of rotations. Each rotation will have an angle of 360/n. For example, an object having C3 symmetry would have three rotations of 120 degrees. Dihedral symmetries differ from cyclic ones in that they have reflections addition symmetries in addition rotational symmetry. Dihedral symmetries are represented with the notation Dn where the represents the number of rotations, as well as the number of reflection mirrors present. Each rotation angle will be equal to 360/n degrees and the angle between each mirror will be 180/n degrees. An object with D4 Symmetry would have four rotations, each of 90 degrees, and four reflection mirrors, with which angle.

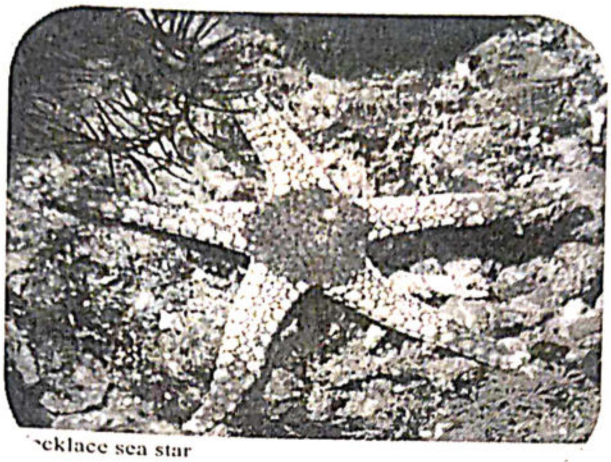
 

❖ Radically Radial: The Sea Star

A star fish provides us with a Dihydral 5 symmetry. Not only do we have five rotations of 72 degrees each, but we also have five lines of reflection.

No head, no tail, all arms –sea stars are just that: stars. Based on five-part radial symmetry (though some sea stars have many more arms), key functions are coordinated in the center of their bodies, then passed down the arms. The sea star has no brain, but a nerve ring in its center, like a relay station that coordinates the movement of its arms. This nervous system relays impulses from light, touch and chemical sensors around its body.

Five arms mean a different way of moving through the world. Sea stars have a water vascular system that radiates as canals down each arm from a central ring canal encircling the mouth. They move on hundreds of tiny, water-filled tube feet, which works well for slow moving, bottom dwelling animals.



ecklace sea star

❖ **Hibiscus:**

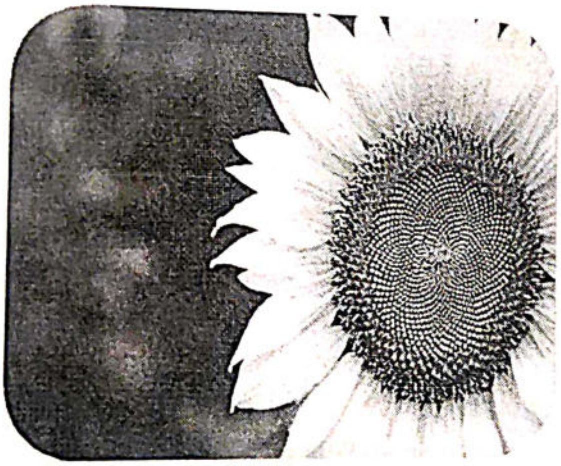
- **C5** symmetry. The petals overlap, so the symmetry might not be readily seen. It will be upon closer examination through.

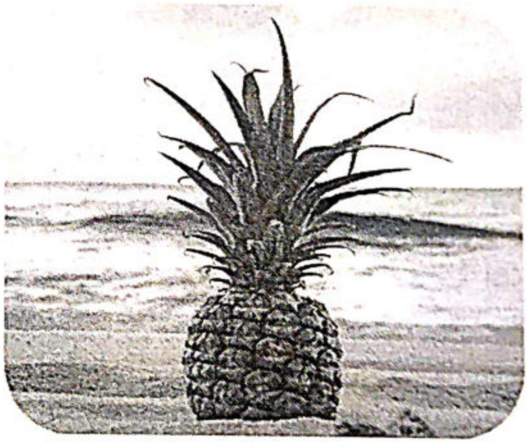
FIBONACCI SPIRAL

- Named for the famous mathematician, Leonardo Fibonacci, this number sequence is a simple, yet profound pattern.

Based on Fibonacci's 'rabbit problem,' this sequence begins with the numbers 1 and 1, and then each subsequent number is found by adding the two previous numbers. Therefore, after 1 and 1, the next number is 2 (1+1). The next number is 3 (1+2) and then 5 (2+3) and so on.

What's remarkable is that **the numbers in the sequence are often seen in nature**.

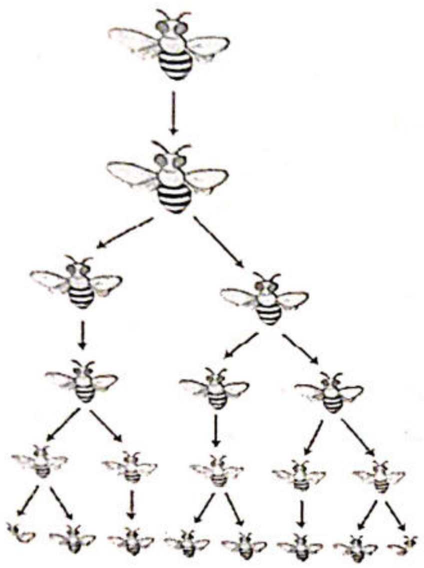




A few examples include the number of spirals in a pine cone, pineapple or seeds in a sunflower, or the number of petals on a flower.

The numbers in this sequence also form a unique shape known as a Fibonacci spiral, which again, we see in nature in the form of shells and the shape of hurricanes.

Fibonacci in plants:



The family tree of a male bee

The emerging fronds of a silver fern (*Alsophila dealbata)*

The pattern also appears in the family tree of bees. An unfertilized egg hatches into a male bee, while a fertilized egg hatches into a female bee. So, a male bee has 1 parent, 2 grandparents, 3 great-grandparents, 5 great-great-grandparents etc.

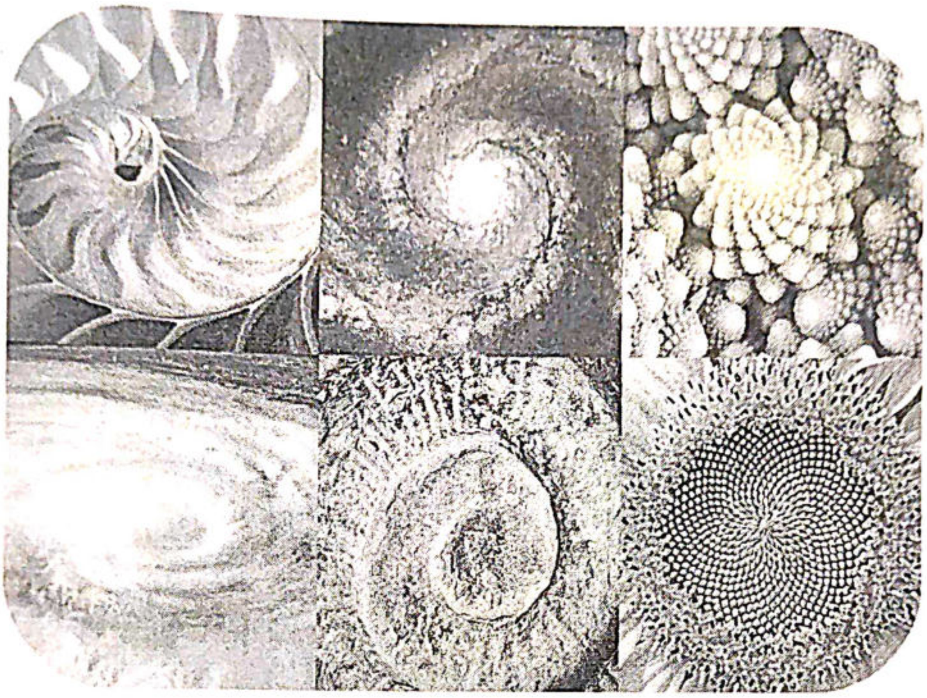
It also appears in how humans inherit the female X chromosome, but that explanation is far too complex for this post.

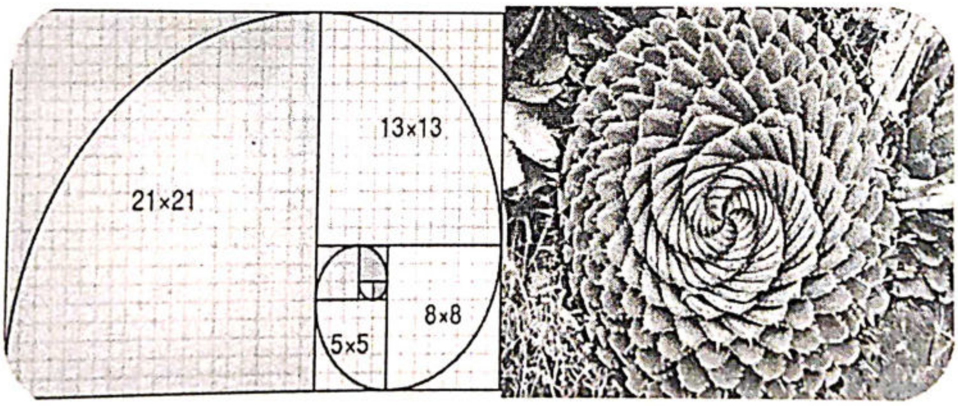
THE GOLDEN RATIO

First written about in 6th century India, the Fibonacci sequence has powerful applications in nature. The basic principle is that if you add the two preceding numbers, you get the third number - for example, $0 + 1 = 1$, $1 + 1 = 2$, $1 + 2 = 3$, $2 + 3 = 5$ and so on.

When you graph this pattern, you get something called a *golden spiral*. In mathematics the ***golden ratio*** that produces this spiral has many applications. In nature it can be seen in plants, shells, snails, genetics, storm pattern, galaxies… all kinds of places.

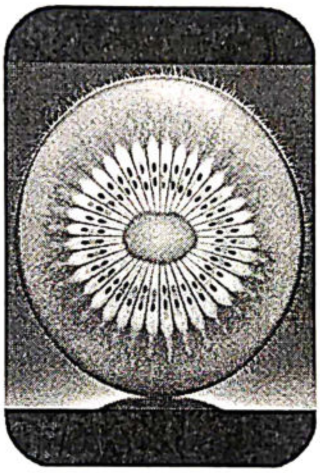
The ratio of consecutive numbers in the Fibonacci sequence approaches a number known as the golden ratio, or phi (=1.618033989). The aesthetically appealing ratio is found in much human architecture and plant life. A Golden Spiral formed in a manner similar to the Fibonacci spiral can be found by tracing the seeds of a sunflower from the Centre outward.




13×13
21×21
8×8
5×5

FRACTALS

A fractal is a never-ending pattern. Fractal are infinitely complex patterns that are self-similar across different scales.They are created by repeating a simple process are over in an ongoing feedback loop.Driven by recursion, fractals are images of dynamic system - the pictures of chaos.



CONCLUSION

Mathematics is everywhere in this universe seldom note it. We enjoy nature and are not interested in going deep about what mathematical idea is in it.

Mathematics express itself everywhere, in all most every facet of life- in nature all about us.

REFRENCE

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THANK YOU