MATHEMATICAL CONCEPTS IN NUMBERS IN NATURE: A MIRROR MAZE

Below are a list of descriptions and definitions associated with the mathematical concepts presented in Numbers in Nature.

Ratios provide clues to the relationship between two things such, as lengths, quantities or volumes. The **Golden Ratio, or phi (ϕ)**, is one of nature’s most common ratios and can be a useful tool to analyze the proportions of many natural and man-made objects. Many things in nature, art, architecture and the man-made world demonstrate proportions that are approximately (but not exactly) the Golden Ratio. The value when the Greek letter phi represents the Golden Ratio is 1.6180339887…The Golden Ratio is present in Fibonacci spirals. Examples: proportion of bone lengths in human hands, insect bodies, DNA molecules.

A **fractal** is a detailed pattern that looks similar at any scale and repeats itself. A fractal’s pattern gets more complex as you observe the fractal at larger scales. Examples: snowflakes, tree branching, lightning, a fern.

**Natural selection** describes how most well-adapted organisms and individuals within a species will tend to survive, so over time, the species will optimize itself for a given set of living conditions.

A **pattern** is a set of shapes or numbers that repeats in a characteristic way and can be described mathematically.

A **geometric pattern** is made up of repeating shapes.

A **numeric pattern**, or **sequence**, is a list of numbers that occur in some predictable way and can be used to describe real-word things (i.e., population growth).

An **additive number sequence** is a set of numbers where each number is equal to the sum of the two numbers that come directly before it in the series.

A **Fibonacci sequence** is a specific additive number sequence where the first two numbers in the sequence are 0 and 1, and each following number is obtained from the sum of two preceding. Examples: the seeds in some sunflower species, number of petals on certain flowers, Romanesco broccoli.

A **ratio** describes the relationship between two numbers, quantities or volumes, and how for every amount of one thing, how much of something else exists. A ratio can be written as a fraction.

A **proportion** describes the relationship between two ratios.

A **spiral** is a curve that starts from a center point (origin) and gets further and further away as it circles around that point. Examples: pinecones, pineapples, hurricanes.
A logarithmic spiral is a special type of spiral where the distance between each turn of the spiral is progressively larger than the one before it. Not all logarithmic spirals are Fibonacci spirals. Examples: a sheep's horn, a nautilus shell.

Something is symmetric if it looks the same on both sides. Objects can be symmetrically reflected across a line, or rotated around a point.

A tessellation is a repeating geometric pattern that fills a space (2D or 3D) entirely without leaving any gaps. The floorplan of the mirror maze is a tessellation of equilateral triangles.

A Voronoi pattern provides clues to nature’s tendency to favor efficiency: the nearest neighbor, shortest path, and tightest fit. Each cell in a Voronoi pattern has a seed point. Everything inside a cell is closer to it than to any other seed. The lines between cells are always halfway between neighboring seeds. Examples: corn on the cob, honeycombs, foam bubbles, the cells in a leaf, giraffe skin, a head of garlic.

# # #