SOUTHERN OHIO Museum

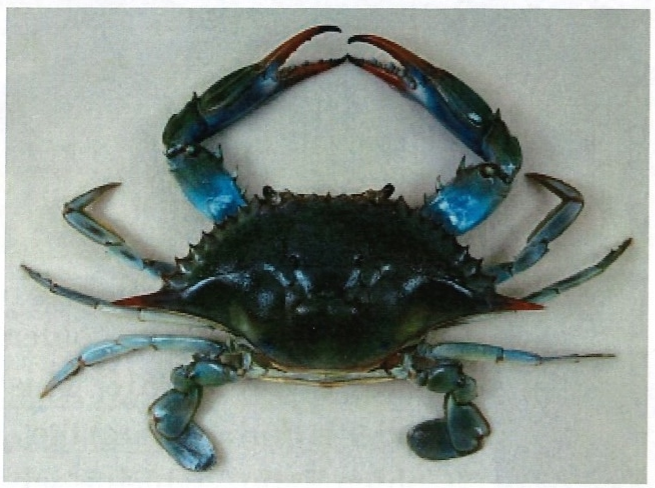
Visual Patterns in Nature

"Patterns are an outward manifestation of an ordered structure and are clues to how things are organized and connected."

-- William C. Graham Jr.

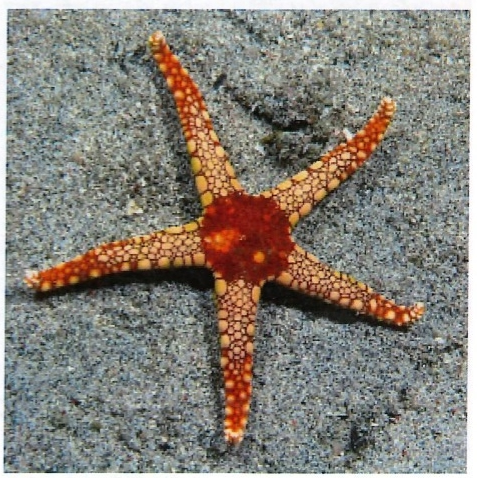
Patterns abound in nature, and are generally related to some type of symmetry.

Symmetry: Balanced proportions that have a correspondence in size, shape and relative position of parts on opposite sides of a dividing line, median plane, or about a center or axis.



Types of Symmetry:

Bilateral Symmetry (Mirror): The property of being divisible into symmetrical halves on either side of a unique plane. Examples of bilateral symmetry include vertebrates like humans.

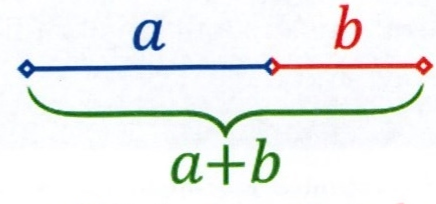


Radial Symmetry (Rotational): The condition of having similar parts regularly arranged around a central axis. Examples of radial symmetry include starfish and daisy flowers.

Sacred Geometry: Symbolic and spiritual meaning ascribed to certain geometric shapes and proportions. Sacred Geometry has been used throughout history in the design of various temples, churches and mosques, along with the creation of artwork. Sacred Geometry has its roots in the study of natural forms.

Fibonacci (Leonardo Bonacci): An Italian mathematician that lived from 1170-1250 A.D. Fibonacci is best known for a number sequence that corresponds to a logarithmic spiral, often called the "Golden Spiral," referring to its relationship to the "Golden Number." The Fibonacci sequence starts with 0 & 1 or 1 & 1, and the next number in the sequence is determined by adding together the previous two numbers. The Fibonacci sequence's pattern of growth matches the forces controlling growth in a large variety of natural dynamical systems. This Golden Spiral is found in nautilus shells and in the arrangement of seeds on the head of a sunflower.

Golden Number: The golden number is Phi, or 1.618. This number is derived from the "Golden Ratio," which is when the ratio of two quantities equals the ratio of their sum to the larger of the two numbers.



$a+b$ is to a as a is to b

Self-Similar: An object that is exactly or approximately similar to a part of itself on a different scale.

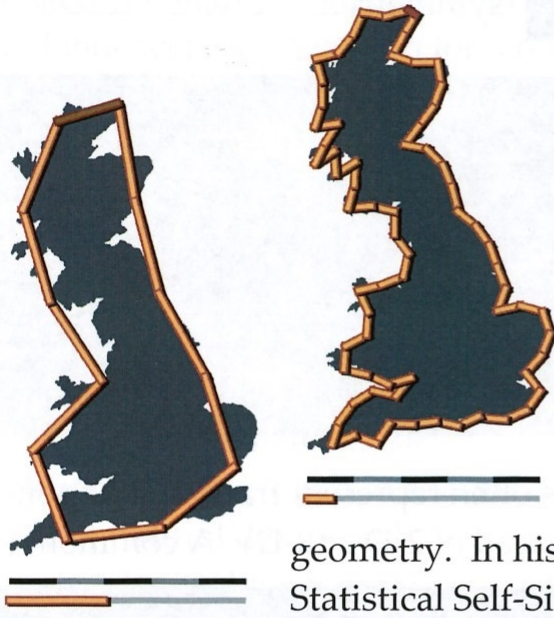
Scale Symmetry: Having self-similar parts on different scales. This is a common property of fractals, which exhibit expanding symmetry.

Fractal: A natural phenomenon or mathematical set that exhibits a repeating pattern that displays at every scale. Fractals are infinitely self-similar. A fractal pattern looks the same close up as it does far away. Fractal images are pictures of a dynamic system that repeats a simple process in an ongoing feedback loop. Fractals often represent fractional or non-integer dimensions (1.8 or 3.3 dimensional instead of 2-D or 3-D). A common example of a fractal in nature is the logarithmic spiral found in galaxies, nautilus shells, and the pattern of seeds on a sunflower head.

Chaos Theory: The qualitative study of unstable aperiodic behavior in deterministic nonlinear dynamical systems. A chaotic system is characterized by extreme sensitivity to initial conditions. The system is determinable and not random. Very slight differences in starting conditions cause major differences later. A fractal image is a visible representation of fractal space that defines the orbit of a deterministic system that behaves chaotically. Chaos theory and fractals are used to explain natural phenomena and complex systems, like weather.

"Clouds are not spheres, mountains are not cones, coastlines are not circles, and bark is not smooth, nor does lightning travel in a straight line."

--Benoit Mandelbrot



Benoit Mandelbrot: A Polish born mathematician that resided in America and France and lived from (1924-2010). Mandelbrot is famous for his contribution to fractal geometry and for coining the term, "fractal." He is known for his "Theory of Roughness," which contains the idea that the world does not exhibit perfect Euclidian geometry. In his 1967 paper, "How Long is the Coast of Britain: Statistical Self-Similarity and Fractional Dimension," Mandelbrot proposes that the measured length increases without limit as the measurement scale decreases toward zero. This idea is echoed in Fractal Geometry and Chaos Theory.

"As far as the laws of mathematics refer to reality, they are not certain, and as far as they are certain, they do not refer to reality."

-- Albert Einstein

Southern Ohio Museum & Cultural Center
825 Gallia St.
Portsmouth, Ohio 45662

Tuesday – Friday 10am-5pm, Saturday 1-5pm
(740)354-5629 www.somacc.com
Always Admission Free!