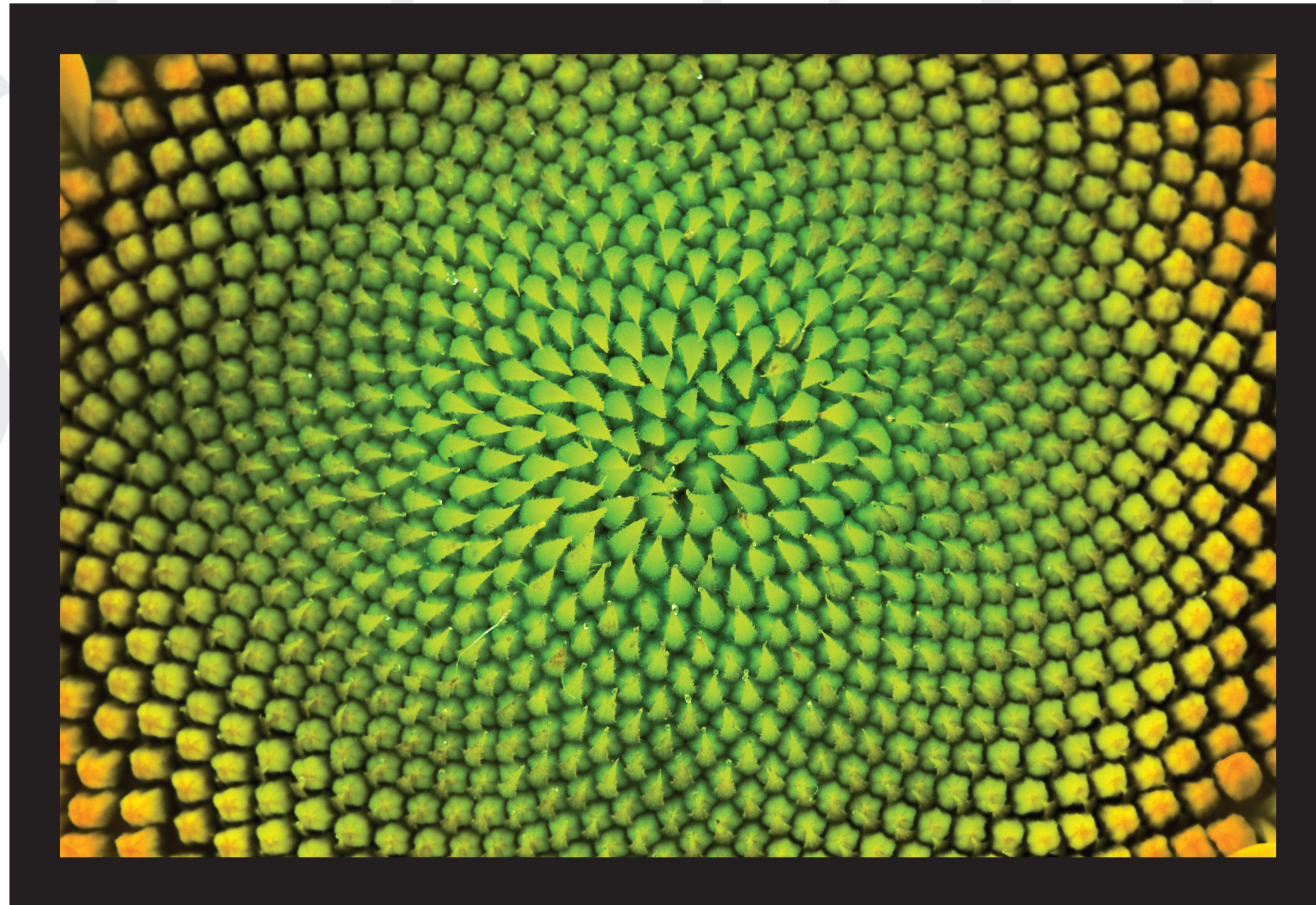


# Numbers in Nature



Much of nature exhibits elegant mathematical patterns.

From tiny flowers to the Solar System and beyond, nature's beauty commonly arises from a mathematical foundation, suggesting something of the brilliant mind of the Creator.

## Fibonacci Sequence

*A mathematical sequence that can be found in the structure of many plants and animals*

This sequence follows the pattern of:

0, 1, 1, 2, 3, 5, 8, 13, 21, 34...

Each number in the sequence is the sum of the two previous numbers:  $0+1=1$ ,  $1+1=2$ ,  $2+1=3$  and so on.

Leonardo of Pisa, known as "Fibonacci" meaning "son of Bonacci," wrote about this sequence of numbers in the 13th century, but this numerical pattern was exhibited by natural phenomena long before its formal description.

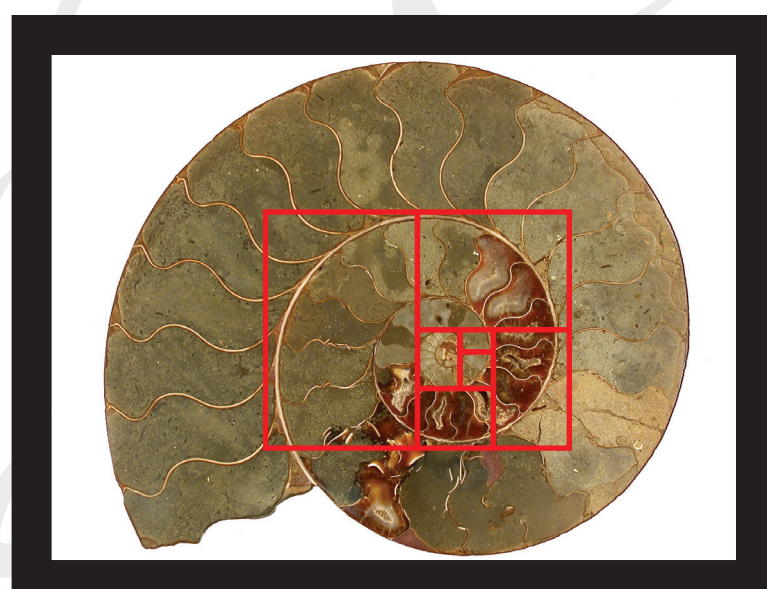
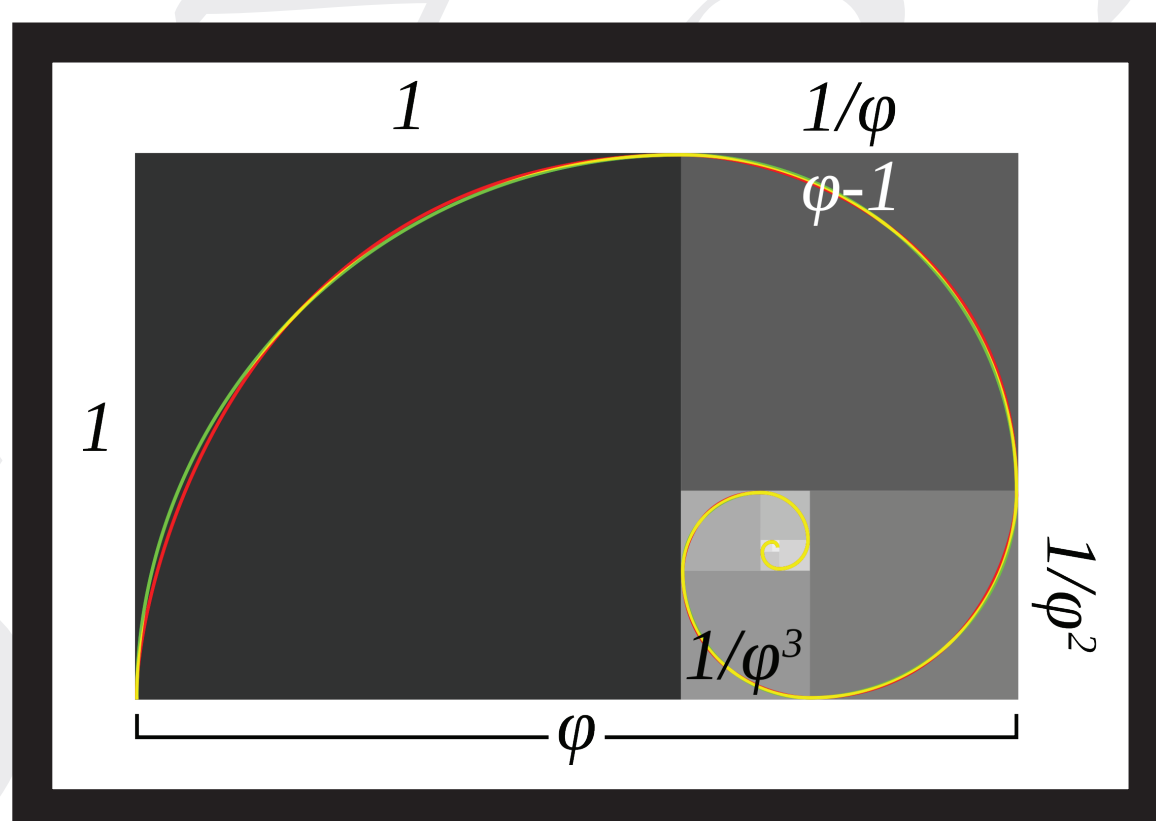
### Plants

The 20,000 member sunflower and daisy plant family (Asteraceae, photo below poster title) exhibits Fibonacci numbers in the number of spirals formed by the florets and seeds in their heads. In the example above, the florets form 34 spirals and 34 is a Fibonacci number. Other spirals form at different slopes, but when counted consistently, they always add up to a Fibonacci number. Patterns exhibiting the Fibonacci sequence are common in other aspects of plant anatomy.

### Animals

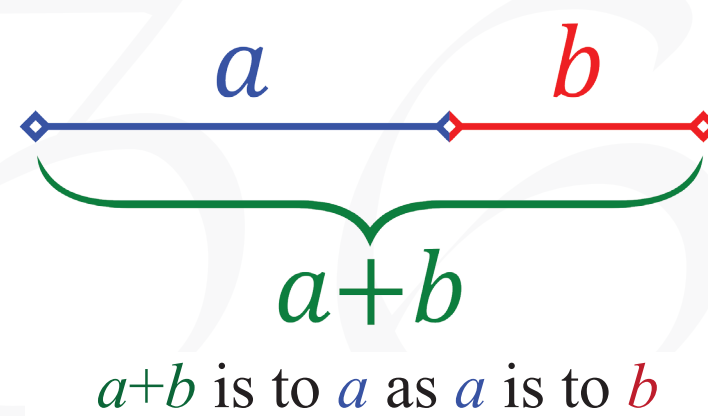
The spiral found in snails and ammonites (below) conforms to the Fibonacci sequence.

If a number in the Fibonacci sequence is divided into the previous number in the sequence, the ratio approximates to a very special number symbolized with the Greek letter  $\phi$ . The further up the sequence one goes, the closer the ratio is to  $\phi$ . This number is the "Golden Ratio."



## Golden Ratio

*This ratio of  $\approx 1:1,6180$  is a ratio that our brains interpret as "beautiful"*



$$\frac{a+b}{a} = \frac{a}{b} = \phi$$

$$\phi = \frac{1 + \sqrt{5}}{2} = 1.6180339887$$

### Architecture

Ratios evident in some Egyptian pyramids suggest that the golden ratio was recognized in ancient times. Though the Egyptians experimented with a variety of slopes and angles, some of their largest pyramids – such as the Great Pyramid at Giza – incorporate proportions which are close to the golden ratio.

The ancient Greeks brought the ratio to prominence with their use of it in both art and architecture. Classical architecture, such as the Parthenon in Athens, has the golden ratio built into its design. In modern times, even the design of some websites use the golden ratio.

### The Human Body

The human body also follows golden ratio patterns. For instance, the length from your feet to your navel and your navel to the top of your head is close to  $\phi$  (1:1.618). The length of your hand to your forearm and the distance from your eyes to your nose and your nose to your chin also typically fall close to the golden ratio.

In fact, it is this symmetry within the body that we recognize as beauty.

