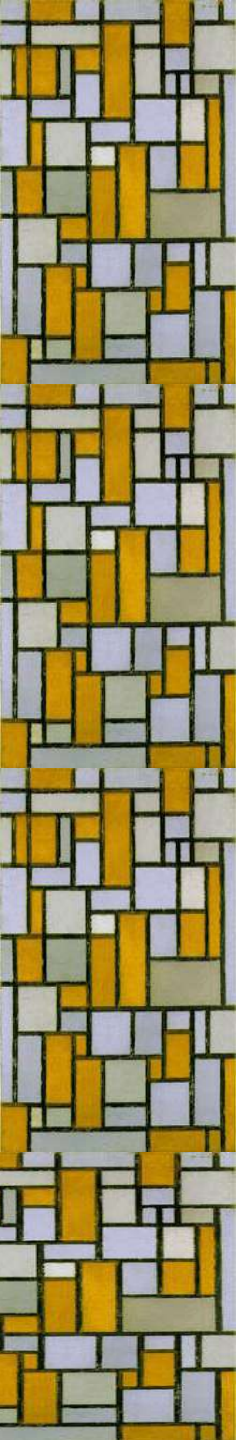


The Golden Ratio

Background

- ***Look at this sequence…***
- 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, . . .
- Can you tell how it was created?
  - Start with the numbers 1 and 1.
  - To get the next number add the previous two numbers together.
- Do you recognize this sequence of numbers?
- It is called the Fibonacci's sequence discovered by a man called none other than Leonardo Fibonacci.

What is the Golden Ratio?

- The relationship of this sequence to the Golden Ratio lies not in the actual numbers of the sequence, but in the ratio of the consecutive numbers.

- Let's look at some of these ratios:

What is the Golden Ratio?

- 2/1 = 2.0
- 3/2 = 1.5
- 5/3 = 1.67
- 8/5 = 1.6
- 13/8 = 1.625
- 21/13 = 1.615
- 34/21 = 1.619
- 55/34 = 1.618
- 89/55 = 1.618

What number do the ratios appear to approach?

The Golden Ratio

- The Golden Ratio is an irrational number
- It is represented the Greek letter phi (or φ, the capital letter: Φ), after Phidias, who is said to have employed it.

The Golden Ratio

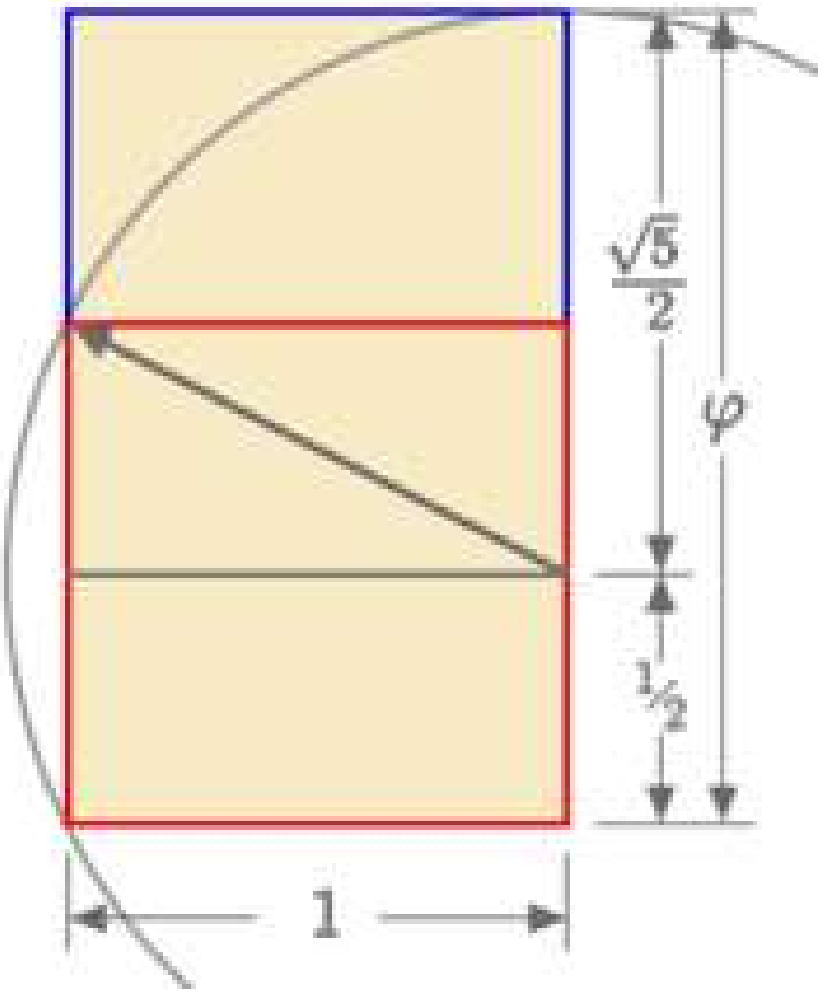
- Golden Ratio goes on forever so it is usually rounded to three decimal places, or 1.618
- The actual ratio is

Irrational Family

- pi, or π
  - 3.141592653 …
- e, the natural logarithm
  - 2.718281828 …
- phi, or φ
  - 1.61803399 …

What it looks like…

The Golden Rectangle



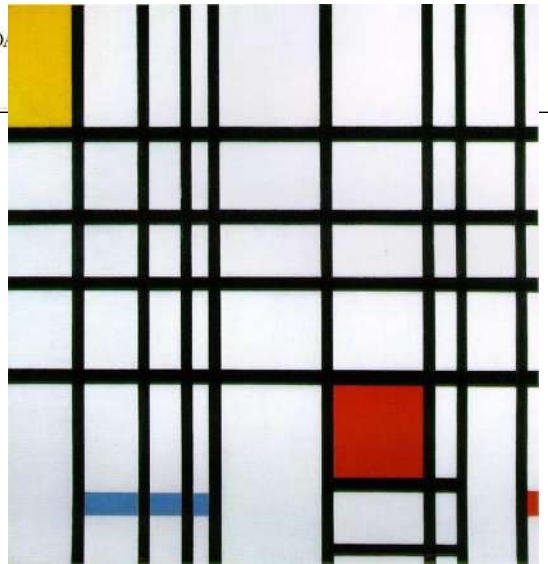
Where does it occur?

- Architecture
  - Some studies of the Acropolis, including the Parthenon, conclude that many of its proportions approximate the golden ratio.

Where does it occur?

- Art
  - Salvador Dalí used the golden ratio in his masterpiece, *The Sacrament of the Last Supper*.
    - The dimensions of the canvas
    - A huge dodecahedron, with edges in golden ratio to one another

  - Mondrian used the golden section extensively in his geometrical paintings.



Where does it occur?

- **Music**
  - In Béla Bartók's *Music for Strings, Percussion and Celesta* the xylophone progression occurs at the intervals 1:2:3:5:8:5:3:2:1.[27]
  - The golden ratio is also apparent in the organization of the sections in the music of Debussy's *Image, Reflections in Water*, in which the sequence of keys is marked out by the intervals 34, 21, 13 and 8.
  - The math metal band Mudvayne have an atmospheric instrumental track called "Golden Ratio" on their first album, *L.D. 50*. Mathematical concepts are also explored in other songs by Mudvayne.

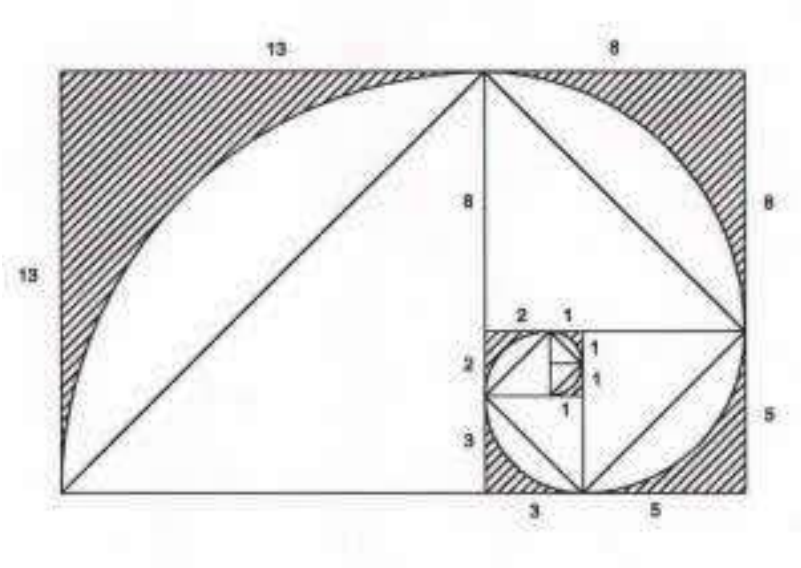
Where does it occur?

- **Nature - Plants**
  - A pinecone: spirals from the center have 5 and 8 arms, respectively (or of 8 and 13, depending on the size)- again, two Fibonacci numbers

  - Scientists speculate that plants that grow in spiral formation do so in Fibonacci numbers because this arrangement makes for the perfect spacing for growth.

Where does it occur?

- **Nature – Animals**
  - **This very special spiral (called the logarithmic spiral) is exactly that of the nautilus shell and of certain snails (the planorbe or flat snail). One finds it also in the horns of certain goats (markhor, girgentana), and in the shape of certain spider's webs.**



Wow!

- One more interesting thing about Phi is its reciprocal.
- If you take the ratio of any number in the Fibonacci sequence to the next number, the ratio will approach the approximation 0.618.
- This is the reciprocal of Phi: 1 / 1.618 = 0.618.
- It is highly unusual for the decimal integers of a number and its reciprocal to be exactly the same.

The Perfect Face

- What is beauty?
  - Why do some faces seem attractive to you?
  - Is there something specific in each of their faces that is attractive or is our attraction governed by one of Nature's rules?
  - Does this have anything to do with the Golden Ratio?
  - You are going to analyze each other's faces to see if the Golden Ratio is present or not.

Assignment

- The Perfect Face
  - Write your name above the word "Perfect" on your paper.
  - Write the name of your partner underneath the face.
  - Follow the instructions and see if your results come close to 1.618 – the golden ratio