"WHAT IS BEAUTIFUL"

STUDENT ACTIVITIES

In this activity, we will investigate the mathematics hidden behind the **Golden Ratio**, also known as the Divine Proportion. We will research its origins observed in everything from plants, snail shells, the Galaxy to architecture application and even body aesthetics.

Initially, we will tour through Augmented Reality, three buildings of the ancient world: the Parthenon, the Pyramid of Giza, and the Sphinx. Firstly, you will install the "Google AR" app on your phones through Google Play. Then you will follow the following links and by clicking "View in your Space" you will be able to visit the ancient monuments virtually.

• **Parthenon**
https://3dwarehouse.sketchup.com/model/844a1de73bed43bb2e4b8b5b39e70c7a/Parthenon

• **Sphinx**
https://3dwarehouse.sketchup.com/model/15d917790ca243aa59aed5538305c915/The-Great-Sphinx-of-Giza-Cairo-Egypt
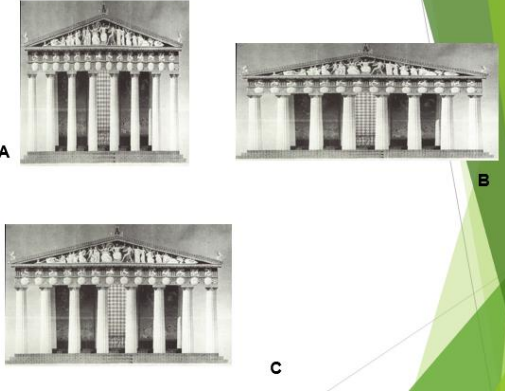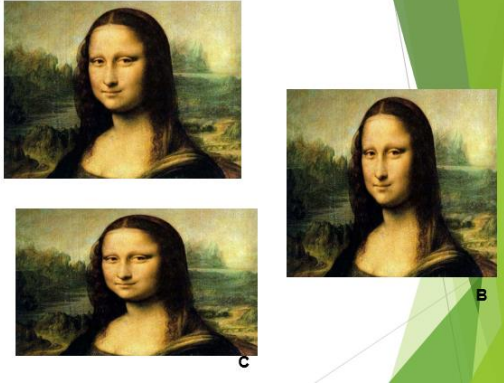
• **Giza Pyramid**
https://3dwarehouse.sketchup.com/model/ccdc9a80847445b38011e704b6406f9/Great-Pyramid-of-Giza-Cairo-Egypt

Discussion will follow as to which building they consider to be more beautiful and why.

A. The Golden Rectangle

<u>Activity 1</u>

    a) Do we all agree as to what is beautiful and if so, why? Discuss in class.

    b) Choose which of the following pictures is more harmonic or more beautiful.

A ☐   B ☐   C ☐   A ☐   B ☐   C ☐

A ☐   B ☐   C ☐

<u>Results</u>

Number of students who chose B	Number of students who chose C	Number of students who chose A

Discussion of the results

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Activity 2:

a) Continue the exploration by drawing a rectangle that you think has the ideal proportions to be the most beautiful rectangle you ever drawn.

b) Now measure its sides and divide the bigger side over the smaller one and complete the following:

A=Bigger side: _____

B=Smaller side: _____

$$\frac{A}{B} = \frac{\text{Bigger side}}{\text{Smaller side}} = \frac{}{} =$$

Discuss your results regarding A/B with the class.

B. *The Golden Ratio*

The golden ratio, also known as the golden number, golden proportion, or the divine proportion, is a ratio between two numbers that equals approximately 1.618. Usually written as the Greek letter phi "Φ", to honor Phidias, one of the architects of Parthenon, who used Golden Ratio in building Parthenon.
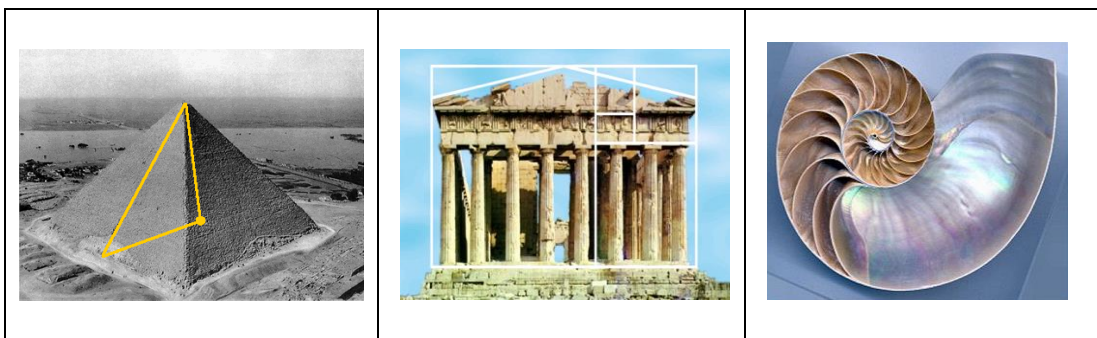
C. The Golden Spiral

In geometry, a golden spiral is a logarithmic spiral whose growth factor is φ, the golden ratio. That is, a golden spiral gets wider (or further from its origin) by a factor of φ for every quarter turn, it makes. Golden spirals are self-similar. The shape is infinitely repeated when magnified.

The Fibonacci spiral is an approximation of the golden spiral created by drawing circular arcs connecting the opposite corners of squares in the Fibonacci tiling.


Activity3:

a) The following sequence is called Fibonacci sequence whose first two numbers are "1". Form groups of four and try to determine the next two numbers on the Fibonacci Sequence

1, 1, 2, 3, 5, 8, 13, 21, 34, _____, _____

b) Discuss with your group what the pattern that forms the Fibonacci sequence is. Communicate yours findings with the class.

c) As group choose any two consecutive numbers of the Fibonacci series and divide the bigger one with the smaller one. Share your result with the class and discuss whether the Golden Ration is hidden in the Fibonacci sequence.

d) The Fibonacci sequence can be represented with squares:
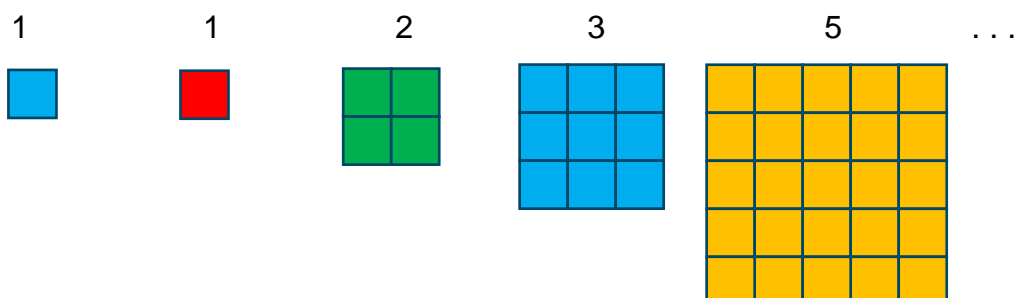
If we place the squares in the following arrangement, we can draw a spiral by travelling through the squares and eventually connecting by the two red dots. Try as a group to draw the spiral by passing through all squares.
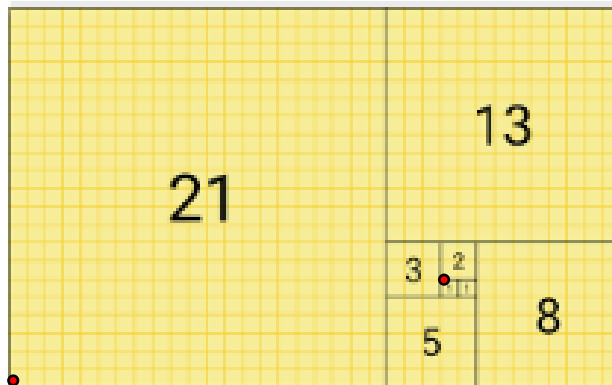

Homework

Search for the golden spiral in nature and present your work in class.

D. __The Human Body__

The golden ratio is found in various aspects of the human body, including facial features, body proportions, hand and finger lengths, and skeletal structures.

❖ In a new study investigating whether __skull__ shape follows the Golden Ratio, Johns Hopkins found that the human skull dimensions followed the Golden Ratio.
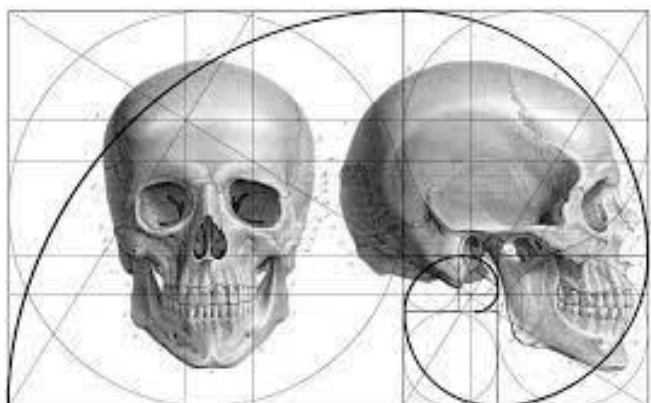
❖ A __facial golden mask__ was developed by Dr. Marquardt, and it contains and includes all of the one-dimensional and two-dimensional geometric golden elements formed from the golden ratio. Dr Marquardt claimed that beauty is universal and beautiful faces conforms to the facial golden mask. Surgeons use this mask in order to reconstruct a face.
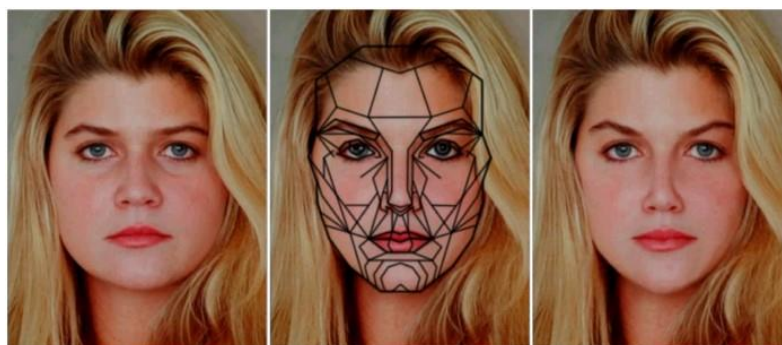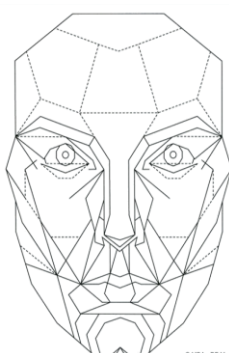

Original   Revise to Marquardt Beauty Mask   Per Beauty Mask

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❖ Some artists and architects believe that the golden ratio makes the most beautiful shapes. As a result, the ratio can be found in many famous buildings and artworks, such as those by **Leonardo da Vinci**.

In The Da Vinci Code, the art historian hero Robert Langdon gives an extended lecture on the number 1.618, which he represents as φ, the Greek letter Phi. This number is supposedly the Golden Ratio.
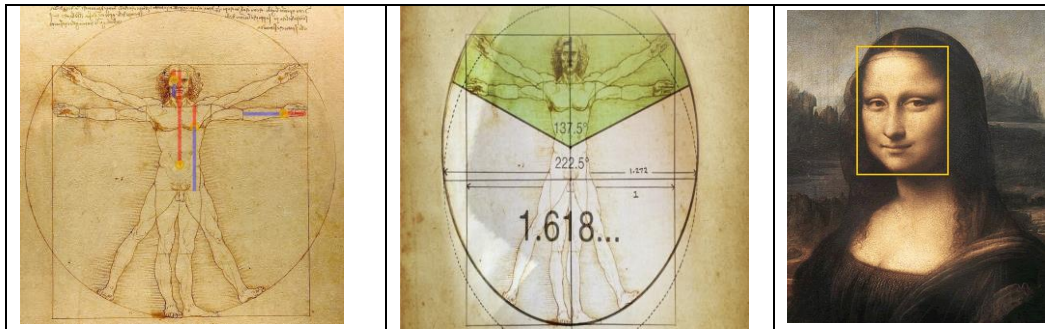
Activity 4

a) Form groups of two and measure different parts of your body in order to reveal the Golden Ratio. For example:
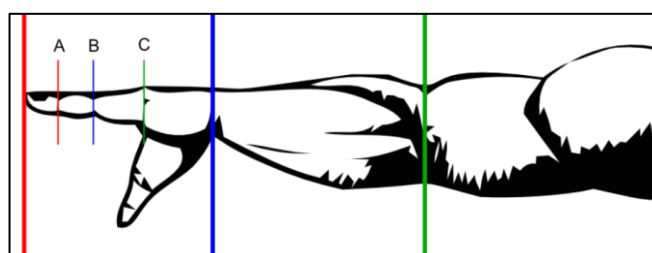
Hands and Fingers

• Measure the length of one finger joint to the length of the next one.

A=Length of one finger joint: _____

B=Length of the next finger joint: _____

• Then divide the length of the next finger joint over the length of one finger joint and write your answer:

$$\frac{B}{A} = \frac{\text{Length of the next finger joint}}{\text{Length of one finger joint}} = \underline{} = $$

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<u>Facial Features</u>:

- Measure the width of your mouth to the distance between your eyes.

  C=Width of your mouth: _____

  D=Distance between your eyes: _____

- Then divide the width of your mouth over the distance between your eyes and write your answer:

$$\frac{C}{D} = \frac{\text{Width of your mouth}}{\text{Distance between your eyes}} = \underline{\quad} =$$

<u>Body Proportions</u>

- Measure the height of your body and the distance of the navel to the feet.

  E=Height of your body: _____

  F=Height from navel to the feet: _____

- Then divide the height of your body to the height from navel to the feet and write your answer:

$$\frac{E}{F} = \frac{\text{Height of your bogy}}{\text{Height from navel to the feet}} = \underline{\quad} =$$

➢ <u>Homework</u>

The golden ratio is an interesting mathematical concept with a variety of applications in nature, in art, in human body and in many other fields. Search and present other fields that Golden ratio is applied on.

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