Donald W. Reynolds Center for the Visual Arts
E.L. Wiegand Gallery

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GOLDEN RATIO

POST-LESSON

GRADE: 5

STANDARDS:

ART: VA:Re8.1.5a Interpret art by analyzing characteristics of form and structure.

MATH: 5.OA.B.3. Analyze patterns and relationships, generate numerical patterns using given rules, identifying apparent relationships between corresponding items.

OBJECTIVE:

Students will be able to interpret form and structure of art by analyzing numerical patterns and relationships.

VOCABULARY:

Golden Ratio: Also known as the Golden Section or the Divine Proportion, this mathematical principle is an expression of the ratio of two sums whereby their ratio is equal to the larger of the two quantities.

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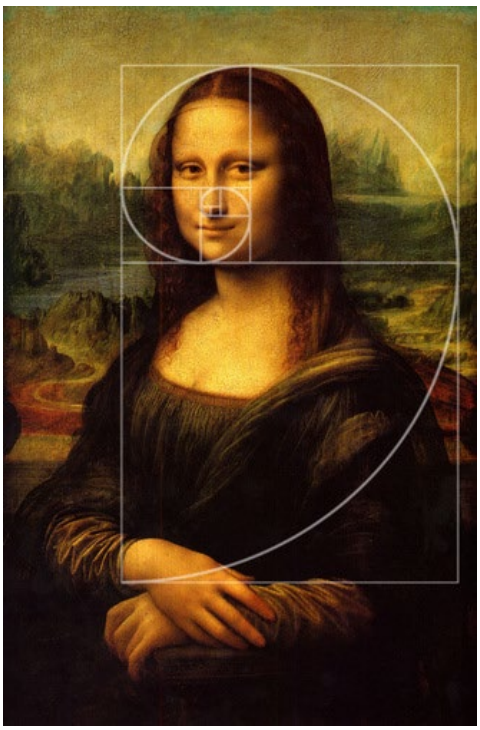
MATERIALS:

- Ruler with Centimeter markings
- Printout of the *Mona Lisa*
- Calculator

TIME: 30-60 minutes



LESSON:

ENGAGEMENT:

Show students the following sequence of numbers, challenge them to find the pattern.

0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377, 610, 987, 1597, 2584, 4181, 6765 . . .

Give students ample time to discuss and discover. When they are ready, have the students share their answers. Students should identify that each number is the sum of the previous two numbers. Challenge them to identify the next few numbers in the sequence (10946, 17711, and 28657).

EXPLORATION:

Tell students that this series of numbers is called the Fibonacci Sequence and that it shows up in art and nature. Pass out the student handout, so each student has a picture of the *Mona Lisa*.

Challenge them to examine the image closely and then discuss where they might be able to find the numbers that make up the Fibonacci Sequence. How could they break up this image into smaller sections with an assigned numerical value?

EXPLANATION:

Pass out rulers. Challenge students to take and record as many measurements as possible. Brainstorm different measurements they could make, such as the length of her face, or the distance from her hands to her chin. Students may measure and record distances on a separate sheet, labeling the endpoints on the printout for reference. For example, for the length of her nose, they might write "from top of nose to tip of nose: 3cm" and draw dots for those endpoints on the printout

ELABORATION:

Once the students have recorded ample measurements, ask them how we might be able to prove that the painting of the *Mona Lisa* contains the Fibonacci Sequence. Discuss as a class. Pass out calculators then have them identify the ratio between numbers on the sequence (answer: about 1.6, 8/5=1.6, 34/21=1.6, 144/89=1.6, please note that the ratio is not apparent for the first few numbers in the series).

Challenge students to use their calculators to find the ratio of the various numbers they collected and recorded. For example, if they divided the length of her face by the length of her nose would it equal 1.6? See how many times they can find a ratio of 1.6 in the measurements they collected.

EVALUATION:

Have them share these findings with each other to verify and discover new relationships. Check in with each student and have them point out and ratios of 1.6. Have the class share what they found. Ideally, you might project the image of the *Mona Lisa* onto a white board and have students label the image with every instance of a ratio of 1.6. See if this creates any new or noticeable patterns and discuss as a class. End the conversation with a discussion of how they were able to use math to better observe the details of this artwork.

EXTENSION:

Have students research the different iterations of Fibonacci numbers (Golden Rectangles, the Golden Ratio, or the Golden Spiral). Have them present and explain how these things are related (ex: Golden Rectangles are rectangles whose sides represent the numbers of the Fibonacci sequence).

Have students research other occurrences of the Fibonacci Sequence in nature. Create a mural of different images or artworks that contain the Fibonacci Sequence, the Golden Ratio, or the Golden Spiral.

Show students video clips that explain and animate the Fibonacci Sequence.

LINKS AND RESOURCES:

https://www.littlewoodcreative.com/newshapes

http://jwilson.coe.uga.edu/EMT668/EMAT6680.2000/Obara/Emat6690/Golden%20Ratio/golden.html