# Maths and the Mona Lisa

Key Learning Content

This film examines possible mathematical patterns within Leonardo da Vinci's painting of the Mona Lisa. The meaning of the Golden Ratio and the Golden Rectangle is explained; next, rectangles are drawn over the Mona Lisa's image; a Golden Spiral is then drawn from the rectangles, suggesting evidence that this may have guided the artist's original design. Although the mathematics of the Golden Ratio can be complex, this film requires little prior mathematical knowledge.
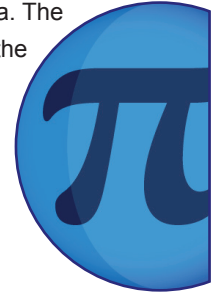
Core Outcomes

Learning Points

- Be able to use ratio notation including reduction to its simplest form and its various links to fraction notation, expressing it in the form $1{:}n$.
- Be able to construct accurate scale drawings illustrating geometrical properties of shapes.

Suggested Activities

- Construct a Golden Spiral from repeated Golden Rectangles.
- Analyse the Mona Lisa and identify possible Golden Ratios in its design.

Extension Outcomes

Learning Points

- Be able to understand how mathematical concepts relate to art and music.
- Be able to set up problems involving direct proportion $y \propto x$ and relate algebraic solutions to graphical representation of the equations.

Suggested Activities

- Measure the distance of the Golden Spiral from its centre every quarter turn, and tabulate and graph the results.
- Find a relationship between the number of quarter turns and the distance from the centre.
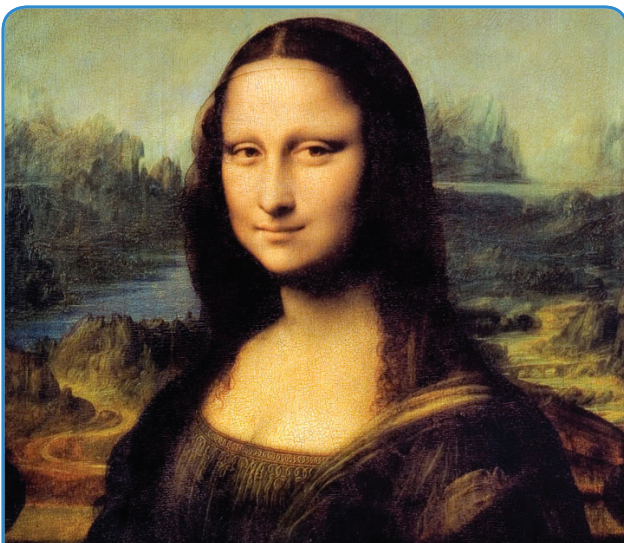
It is believed that many artists of the Renaissance period used the Golden Ratio to create more aesthetically pleasing images.

Related Films 🎥

To use before the lesson plan:

The Fibonacci Sequence

This film describes the sequence associated with growth in the natural world where the ratio between consecutive terms tends to the Golden Ratio.

The History of the Golden Ratio

This film explains how the Golden Ratio has been used by architects and artists throughout history.

To use after the lesson plan:

The Beauty Formula

This film argues that our perceptions of beauty are profoundly influenced by symmetry and the Golden Ratio.

Spirals in Nature

This film shows how the Golden Spiral and other spirals appear regularly in nature.

Proportion: The Vitruvian Man

This film demonstrates the use of proportion in another work by Leonardo da Vinci.

Guide Lesson Plan

Introduction

Show students the Mona Lisa and ask them what they know about it. Confirm that it is probably the most famous painting known. Ask them why they think this image is so appealing.

Show Film 🎥

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Main Activity

Foundation

Get students to construct a Golden Spiral. First draw a small rectangle in the centre of a blank sheet of paper with sides approximately 1cm and 1.6cm. Add a square to the longer side, to form a new rectangle with sides approximately 2cm and 1.6cm. Repeat the process until they run out of space. Then draw a smooth curve made up of quarter-circles drawn within each of the squares in the diagram (as shown in the film).

Advanced

Do the task above, but also measure the distance of the spiral from its centre every quarter-turn and make a table of the results. Plot a graph of number of quarter turns (x) against distance (y) and interpret results. What algebraic equation could be written linking y and x?

Extension Activity

Hand out copies of the Mona Lisa and repeat the spiral designs on the picture. Let students experiment with different starting points (centres of the spiral) and orientations (clockwise/anticlockwise turns). Review attempts at end of lesson and choose the most convincing spiral.

Optional Extra

The Mona Lisa was painted by Leonardo da Vinci, an Italian artist who also painted other famous images. Research Leonardo's work and see if other paintings also show the influence of the Golden Ratio.
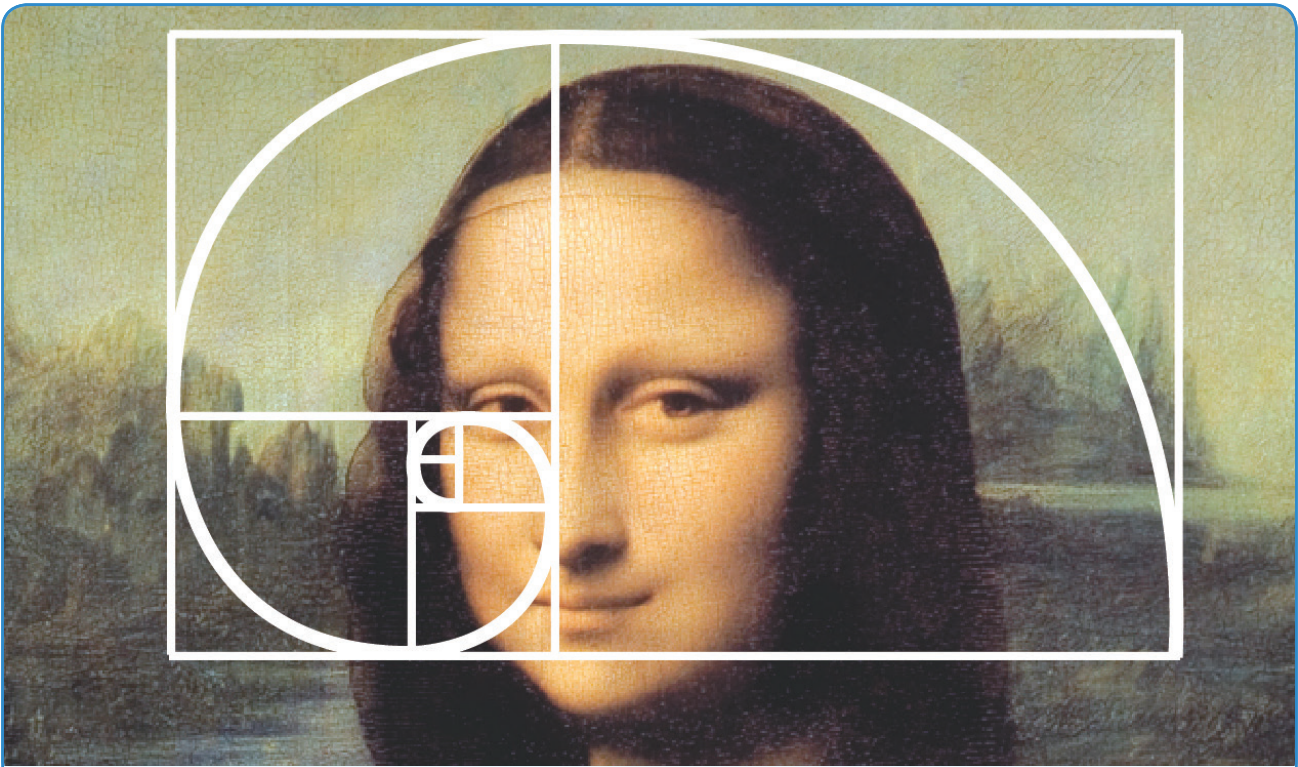
The Golden Ratio can be drawn using lines.
In the case of the Mona Lisa, the culmination of these lines
show a distinct pattern, known as the Golden Spiral.