The History of the Golden Ratio

Key Learning Content

This film gives a high-level overview of occurrences of the Golden Ratio throughout history, from the building of the pyramids and the Parthenon in Athens, the art of Leonardo da Vinci and the music of Debussy, to present day skyscraper design. The Golden Ratio is defined and its approximate value stated. The film will be accessible to all students; follow-on work can range from simple drawing and measurement to complex quadratic algebra, at the teacher's discretion.

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 Golden Rectangles with sides in the Golden Ratio.
- Analyse scale drawings of the Parthenon and identify Golden Ratios in its design.

Euclid identified and named the Golden Ratio. Along with other Greek mathematicians of the time, he saw ratios and geometry as symbols of heavenly importance.

Extension Outcomes

Learning Points

- Be able to understand how mathematical concepts relate to art and music.
- Be able to understand the concepts of an irrational number and a surd.
- Be able to form and solve quadratic equations from data given in a context.
- Be able to understand and use the geometrical properties that similar figures have corresponding lengths in the same ratio but that corresponding angles remain unchanged.

Suggested Activities

- Construct a pentagon using ruler, compass and protractor.
- Form an expression for the ratio between the side of a pentagon and its diagonal.
- Using algebra, show that the side and diagonal of a pentagon are in the Golden Ratio, and calculate its exact value.

Related Films

To use before the lesson plan:

Ratios: Currency Exchange	This film shows how simple ratios are used to express exchange rates for tourists travelling to other countries.
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.
Irrational Numbers: Pythagoras	This film tells the story of how irrational numbers such as Pi and the Golden Ratio, were first discovered by the ancient Greeks, causing great consternation and discord.

To use after the lesson plan:

Maths and the Mona Lisa	This film analyses in some detail the Golden Rectangle patterns found in the Mona Lisa.
Spirals in Nature	This film shows how the Golden Spiral and other spirals regularly appear in nature.
Building the Pyramids	This film explores ways in which mathematics may have been used to design the pyramids.

Guide Lesson Plan

Introduction

Ask students to write down any two numbers then add the two numbers together. Add the new number to the previous number. Repeat this process ten or more times (as in the Fibonacci Sequence). Calculate the ratio of the last two numbers formed by dividing one by another. Almost all students will have a ratio of approximately 1:1.618, the Golden Ratio.

Show Film

The History of the Golden Ratio

Main Activity

Foundation

Get students to 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. Check that all rectangles will then have sides in the Golden Ratio.

Main Activity cont...

Advanced

Get students to construct a regular pentagon using a protractor. Measure the length of a side of the pentagon, and the length of a diagonal between non-adjacent vertices. This should be in the Golden Ratio.

Extension Activity

Foundation

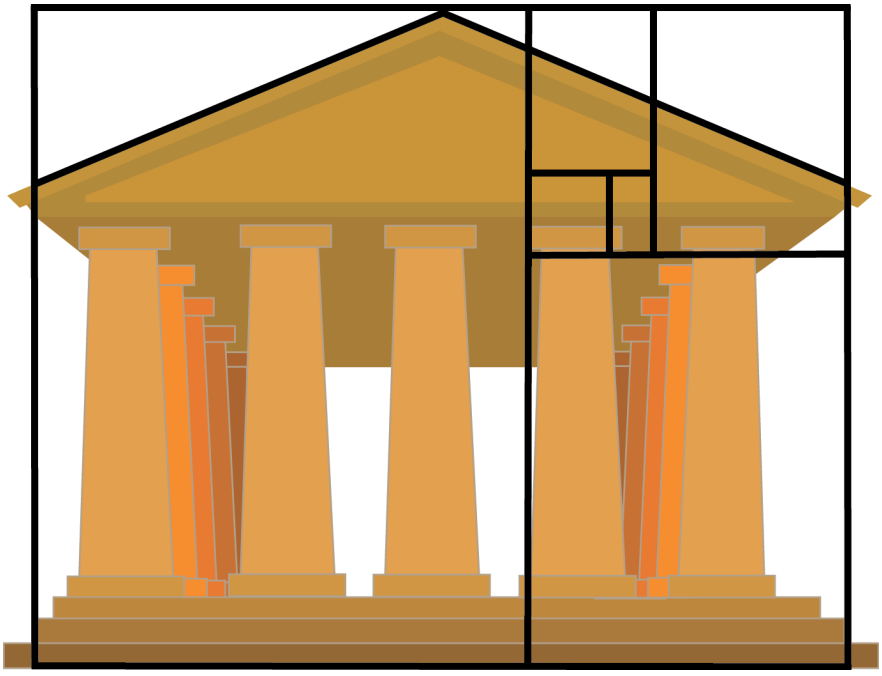
Give students diagrams of the floor plan and front elevation of the Parthenon. Get students to measure distances within the diagrams and identify Golden Ratios in its design.

Advanced

Take the pentagons which the students have drawn and mark the side of the pentagon as one unit in length and the diagonal as x units in length. By considering similar triangles within the pentagon, prove that x satisfies the equation $1/x=x-1$. Form a quadratic equation and solve using the quadratic formula to calculate the exact (surd) value of the Golden Ratio (1:(1+root 5)/2).

Optional Extra

It is often claimed that the Golden Ratio is found in the dimensions of everyday objects, from books to TV screens, credit cards and MP3 players. Get students to collect their own data for these and similar objects in order to test this claim.



The floor plans and façade of the Parthenon, in Athens, are believed to have drawn on the aesthetically pleasing properties of the Golden Ratio.