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Golden Ratio and the Fibonacci Sequence

1. The Fibonacci sequence

1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, … Each term is the **sum of the two before it**: F(n) = F(n−1) + F(n−2).

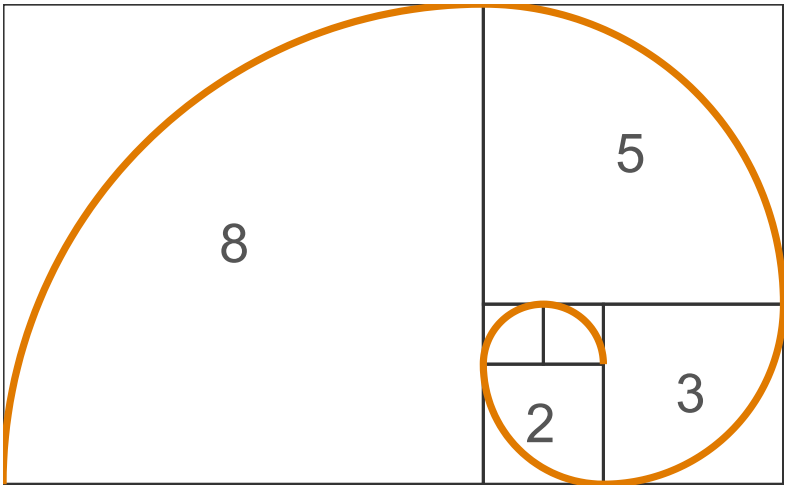
2. The golden ratio

Divide each term by the one before it:

Fraction	2/1	3/2	5/3	8/5	13/8	21/13	34/21
Value	2	1.5	1.667	1.6	1.625	1.615	1.619

The values swing above and below, and settle on the **golden ratio φ = (1 + √5)/2 ≈ 1.618**.

3. The golden spiral



Squares of sides 1, 1, 2, 3, 5, 8 tile a 13 × 8 rectangle (13/8 ≈ φ). A quarter circle in each square, joined end to end, draws the golden spiral.

4. In nature

Each new sunflower seed grows about **137.5°** (the golden angle, 360°/φ²) round from the last. This angle never lines seeds into rows, so they pack **without gaps**; at 135° (3/8 of a turn) they form 8 spokes with gaps. The seed spirals then come in consecutive Fibonacci counts, often **34 and 55**. Pinecones often show 8 and 13 spirals, and many flowers have 3, 5 or 8 petals. Not every spiral in nature is golden (the nautilus shell's is not).

Solved example

Q. Two consecutive Fibonacci numbers are 55 and 89. Find the next two and the ratio of the last pair.
A. 55 + 89 = 144; 89 + 144 = 233. 233/144 ≈ **1.618**.

Practice questions

1. (MCQ) The term after 21 and 34 is (a) 45 (b) 55 (c) 68 (d) 89
2. (Very short) Write φ in surd form.
3. (Short) Why do sunflower seeds pack without gaps?
4. (Numerical) Compute 55/34 to three decimals.
5. (Short) What shape do squares of Fibonacci sides with quarter arcs make?
6. (True/False) Every flower has a Fibonacci number of petals.

Answer key

1. (b) 55.
2. $(1 + \sqrt{5})/2$.
3. Each seed grows 137.5° from the last, an angle that never repeats into rows.
4. 1.618.
5. The golden spiral.
6. False: many do, not all.

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