A tiling with squares whose sides are successive Fibonacci numbers in length

A Fibonacci spiral, created by drawing arcs connecting the opposite corners of squares in the Fibonacci tiling shown above – see golden spiral

In mathematics, the Fibonacci numbers form a sequence defined by the following recurrence relation:

\[
F(n) := \begin{cases} 
0 & \text{if } n = 0, \\
1 & \text{if } n = 1, \\
F(n-1) + F(n-2) & \text{if } n > 1.
\end{cases}
\]

That is, after two starting values, each number is the sum of the two preceding numbers. The first Fibonacci numbers (sequence [A000045](https://oeis.org/A000045) in OEIS), also denoted as \( F_n \), for \( n = 0, 1, \ldots \), are:

0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377, 610, 987, 1597, 2584, 4181, 6765, 10946, 17711, 28657, 46368, 75025, 121393, ...

(Sometimes this sequence is considered to start at \( F_1 = 1 \), but in this article it is regarded as beginning with \( F_0 = 0 \).)

The Fibonacci numbers are named after Leonardo of Pisa, known as Fibonacci, although they had been described earlier in India. [1][2]
Origins

The Fibonacci numbers first appeared, under the name mātrāmeru (mountain of cadence), in the work of the Sanskrit grammarian Pingala (Chandah-shāstra, the Art of Prosody, 450 or 200 BC). Prosody was important in ancient Indian ritual because of an emphasis on the purity of utterance. The Indian mathematician Virahanka (6th century AD) showed how the Fibonacci sequence arose in the analysis of metres with long and short syllables. Subsequently, the Jain philosopher Hemachandra (c. 1150) composed a well-known text on these. A commentary on Virahanka's work by Gopāla in the 12th century also revisits the problem in some detail.

Sanskrit vowel sounds can be long (L) or short (S), and Virahanka's analysis, which came to be known as mātrā-vṛttā, wishes to compute how many metres (mātrās) of a given overall length can be composed of these syllables. If the long syllable is twice as long as the short, the solutions are:

- 1 mora: S (1 pattern)
- 2 morae: SS; L (2)
- 3 morae: SSS, SL; LS (3)
- 4 morae: SSSS, SSL, SLS, LSS; LSS, LSL, LLS (5)
- 5 morae: SSSSS, SSSL, SSLS, LSSS, LSSL, SLSS, SLLL, SLLS, SLLS, LSSL, LSL, SLL, LLS (8)
- 6 morae: SSSS, SSSL, SSLS, LSSS, SLLL, SLLS, LSSL, SLL, LSL, SLL, LLS, LLL (13)
- 7 morae: SSSSSS, SSSSL, SSSL, SSLS, LSSS, SSSL, SLLL, SLLS, LSSL, SSL, LSS, LSS, SLL, LLL, LL (21)

A pattern of length \( n \) can be formed by adding S to a pattern of length \( n-1 \), or L to a pattern of length \( n-2 \); and the prosodists showed that the number of patterns of length \( n \) is the sum of the two previous numbers in the series. Donald Knuth reviews this work in The Art of Computer Programming as equivalent formulations of the bin packing problem for items of lengths 1 and 2.

In the West, the sequence was first studied by Leonardo of Pisa, known as Fibonacci, in his Liber Abaci (1202)[3]. He considers the growth of an idealised (biologically unrealistic) rabbit population, assuming that:

- in the first month there is just one newly-born pair,
- new-born pairs become fertile from their second month on
- each month every fertile pair begets a new pair, and
- the rabbits never die

Let the population at month \( n \) be \( F(n) \). At this time, only rabbits who were alive at month \( n-2 \) are fertile and produce offspring, so \( F(n-2) \) pairs are added to the current population of \( F(n-1) \). Thus the total is \( F(n) = F(n-1) + F(n-2) \).[4]

The bee ancestry code

Fibonacci numbers also appear in the description of the reproduction of a population of idealized bees, according to the following rules:

- If an egg is laid by an unmated female, it hatches a male.
- If, however, an egg was fertilized by a male, it hatches a female.

Thus, a male bee will always have one parent, and a female bee will have two.

If one traces the ancestry of any male bee (1 bee), he has 1 female parent (1 bee). This female had 2 parents, a male and a female (2 bees). The female had two parents, a male and a female, and the male had one female (3 bees). Those two females each had two parents, and the male had one (5 bees). This sequence of numbers of parents is the Fibonacci sequence.[5]
This is an idealization that does not describe actual bee ancestries. In reality, some ancestors of a particular bee will always be sisters or brothers, thus breaking the lineage of distinct parents.

[edit] Relation to the golden ratio

[edit] Golden ratio defined

The golden ratio \( \varphi \) (phi), also written \( \tau \) (tau), is defined as the ratio that results when a line is divided so that the whole line has the same ratio to the larger segment as the larger segment has to the smaller segment. Expressed algebraically, normalising the larger part to unit length, it is the positive solution of the equation:

\[
x \frac{1}{1 - x} = 1 \text{ or equivalently } x^2 - x - 1 = 0,
\]

which is equal to:

\[
\varphi = \frac{1 + \sqrt{5}}{2} = 0.5 + \sqrt{1.25} \approx 1.61803398874984848204586834366.
\]

[edit] Closed form expression

Like every sequence defined by linear recurrence, the Fibonacci numbers have a closed-form solution. It has become known as Binet's formula, even though it was already known by Abraham de Moivre:

\[
F(n) = \frac{\varphi^n - (1 - \varphi)^n}{\sqrt{5}} = \frac{\varphi^n - (-\varphi)^{-n}}{\sqrt{5}},
\]

where \( \varphi \) is the golden ratio (note, that \( 1 - \varphi = -1/\varphi \) from the defining equation above).

The Fibonacci recursion

\[
F(n + 2) - F(n + 1) - F(n) = 0
\]

is similar to the defining equation of the golden ratio in the form

\[
x^2 - x - 1 = 0,
\]

which is also known as the generating polynomial of the recursion.

Proof (by induction):

Any root of the equation above satisfies \( x^2 = x + 1 \), and multiplying by \( x^{n-1} \) shows:
\[ x^{n+1} = x^n + x^{n-1} \]

By definition \( \varphi \) is a root of the equation, and the other root is \( 1 - \varphi = -1/\varphi \). Therefore:
\[ \varphi^{n+1} = \varphi^n + \varphi^{n-1} \]

and
\[ (1 - \varphi)^{n+1} = (1 - \varphi)^n + (1 - \varphi)^{n-1}. \]

Note that both \( \varphi^n \) and \( (1 - \varphi)^n = (-1/\varphi)^n \) are geometric series (for \( n=1,2,3,\ldots \)), which at the same time satisfy the Fibonacci recursion. The first series is exponentially growing, while the latter is exponentially tending to zero, alternating its sign. Because of the linearity of the Fibonacci recursion, any linear combination of these two series will also satisfy the recursion. These linear combinations form a two-dimensional linear vector space, and our job now is to find the original Fibonacci sequence in this space.

Linear combinations of series \( \varphi^n \) and \((1 - \varphi)^n\), with coefficients \( a \) and \( b \), can be defined by
\[ F_{a,b}(n) = a \varphi^n + b(1 - \varphi)^n \] for any real \( a, b \).

All thus defined series satisfy the Fibonacci recursion
\[
F_{a,b}(n + 1) = a \varphi^{n+1} + b(1 - \varphi)^{n+1}
= a(\varphi^n + \varphi^{n-1}) + b((1 - \varphi)^n + (1 - \varphi)^{n-1})
= a \varphi^n + b(1 - \varphi)^n + a \varphi^{n-1} + b(1 - \varphi)^{n-1}
= F_{a,b}(n) + F_{a,b}(n-1).
\]

Requiring that \( F_{a,b}(0) = 0 \) and \( F_{a,b}(1) = 1 \) yields \( a = 1/\sqrt{5} \) and \( b = -1/\sqrt{5} \), resulting in the formula of Binet we started with. It has been shown that this formula satisfies the Fibonacci recursion. Furthermore, an explicit check can be made:
\[
F_{a,b}(0) = \frac{1}{\sqrt{5}} - \frac{1}{\sqrt{5}} = 0
\]

and
\[
F_{a,b}(1) = \frac{\varphi}{\sqrt{5}} - \frac{(1 - \varphi)}{\sqrt{5}} = -1 + 2\varphi = \frac{-1 + (1 + \sqrt{5})}{\sqrt{5}} = 1,
\]
establishing the base cases of the induction, proving that
\[ F(n) = \frac{\varphi^n - (1 - \varphi)^n}{\sqrt{5}} \]
for all \( n \).

For any two starting values, a combination \( a,b \) can be found such that the function \( F_{a,b}(n) \) is the exact closed formula for the series.

Since \( |1 - \varphi|^n / \sqrt{5} < 1/2 \) for all \( n \geq 0 \), \( F(n) \) is the closest integer to \( \varphi^n / \sqrt{5} \). For
computational purposes, this is expressed using the floor function:

\[ F(n) = \left\lfloor \frac{\varphi^n}{\sqrt{5}} + \frac{1}{2} \right\rfloor. \]

**[edit] Limit of consecutive quotients**

Johannes Kepler pointed out that the ratio of consecutive Fibonacci numbers converges, stating that "...as 5 is to 8 so is 8 to 13, practically, and as 8 is to 13, so is 13 to 21 almost” and concludes that the limit approaches the golden ratio \( \varphi \) [6]

\[
\lim_{n \to \infty} \frac{F(n+1)}{F(n)} = \varphi.
\]

This convergence does not depend on the starting values chosen, excluding 0, 0.

**Proof:**

It follows from the explicit formula that for any real \( a \neq 0, b \neq 0 \):

\[
\lim_{n \to \infty} \frac{F_{a,b}(n+1)}{F_{a,b}(n)} = \lim_{n \to \infty} \frac{a\varphi^{n+1} - b(1 - \varphi)^{n+1}}{a\varphi^n - b(1 - \varphi)^n} = \lim_{n \to \infty} \frac{a\varphi - b(1 - \varphi)(\frac{1-\varphi}{\varphi})^n}{a - b(\frac{1-\varphi}{\varphi})^n} = \varphi
\]

because \( \left| \frac{1-\varphi}{\varphi} \right| < 1 \) and thus \( \lim_{n \to \infty} \left( \frac{1-\varphi}{\varphi} \right)^n = 0 \)

**[edit] Decomposition of powers of Golden ratio**

Since the Golden ratio itself is defined by

\[ \varphi^2 = \varphi + 1, \]

this expression can be used to decompose higher powers \( \varphi^n \) as a linear function of lower powers, which in turn can be decomposed all the way down to a linear combination of \( \varphi \) and 1. The resulting recurrence relationships yield Fibonacci numbers as the linear coefficients in a beautiful way, thus closing the loop:

\[ \varphi^n = F(n)\varphi + F(n - 1). \]

This expression is also true for \( n < 1 \), if the Fibonacci numbers \( F(n) \) are extended into negative direction using the Fibonacci rule \( F(n) = F(n - 1) + F(n - 2) \).

**[edit] Matrix form**

A 2-dimensional system of linear difference equations that describes the Fibonacci sequence is
\begin{align*}
\begin{pmatrix} F_{k+2} \\ F_{k+1} \end{pmatrix} &= \begin{pmatrix} 1 & 1 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} F_{k+1} \\ F_k \end{pmatrix} \\
\text{or} \\
\tilde{F}_{k+1} &= A\tilde{F}_k.
\end{align*}

The eigenvalues of the matrix $A$ are $\varphi$ and $(1-\varphi)$, and the elements of the eigenvectors of $A$, \[
\begin{pmatrix} \varphi \\ 1 \end{pmatrix} \quad \text{and} \quad \begin{pmatrix} 1 \\ -\varphi \end{pmatrix},
\]
are in the ratios $\varphi$ and $(1-\varphi)$.

This matrix has a determinant of $-1$, and thus it is a $2 \times 2$ unimodular matrix. This property can be understood in terms of the continued fraction representation for the golden ratio:

\[
\varphi = 1 + \cfrac{1}{1 + \cfrac{1}{1 + \cfrac{1}{\ddots}}}
\]

The Fibonacci numbers occur as the ratio of successive convergents of the continued fraction for $\varphi$, and the matrix formed from successive convergents of any continued fraction has a determinant of $+1$ or $-1$.

The matrix representation gives the following closed expression for the Fibonacci numbers:

\[
\begin{pmatrix} 1 & 1 \\ 1 & 0 \end{pmatrix}^n = \begin{pmatrix} F_{n+1} & F_n \\ F_n & F_{n-1} \end{pmatrix}.
\]

Taking the determinant of both sides of this equation yields Cassini's identity

\[
F_{n+1}F_{n-1} - F_n^2 = (-1)^n.
\]

Additionally, since $A^mA^n = A^{m+n}$ for any square matrix $A$, the following identities can be derived:

\[
\begin{align*}
F_n^2 + F_{n-1}^2 &= F_{2n-1}, \\
F_{n+1}F_m + F_nF_{m-1} &= F_{m+n}.
\end{align*}
\]

**[edit] Recognizing Fibonacci numbers**

Occasionally, the question may arise whether a positive integer $z$ is a Fibonacci number. Since $F(n)$ is the closest integer to $\varphi^n/\sqrt{5}$, the most straightforward test is the identity

\[
F \left( \left\lfloor \log_\varphi (\sqrt{5}z) + \frac{1}{2} \right\rfloor \right) = z,
\]

which is true if and only if $z$ is a Fibonacci number.
A slightly more sophisticated test uses the fact that the convergents of the continued fraction representation of $\varphi$ are ratios of successive Fibonacci numbers, that is the inequality

$$\left| \varphi - \frac{p}{q} \right| < \frac{1}{q^2}$$

(with coprime positive integers $p, q$) is true if and only if $p$ and $q$ are successive Fibonacci numbers. From this one derives the criterion that $z$ is a Fibonacci number if and only if the intersection of the closed interval

$$\left[ \varphi z - \frac{1}{z}, \varphi z + \frac{1}{z} \right]$$

with the positive integers $\mathbb{N}$ is not empty.[7]

[edit] Identities

1. $F(n + 1) = F(n) + F(n - 1)$
2. $F(0) + F(1) + F(2) + \ldots + F(n) = F(n + 2) - 1$
3. $F(1) + 2 F(2) + 3 F(3) + \ldots + n F(n) = n F(n + 2) - F(n + 3) + 2$
4. $F(0)^2 + F(1)^2 + F(2)^2 + \ldots + F(n)^2 = F(n) F(n + 1)$

These identities can be proven using many different methods. But, among all, we wish to present an elegant proof for each of them using combinatorial arguments here. In particular, $F(n)$ can be interpreted as the number of ways summing 1's and 2's to $n - 1$, with the convention that $F(0) = 0$, meaning no sum will add up to $-1$, and that $F(1) = 1$, meaning the empty sum will "add up" to 0. Here the order of the summands matters. For example, $1 + 2$ and $2 + 1$ are considered two different sums and are counted twice.

[edit] Proof of the first identity

Without loss of generality, we may assume $n \geq 1$. Then $F(n + 1)$ counts the number of ways summing 1's and 2's to $n$.

When the first summand is 1, there are $F(n)$ ways to complete the counting for $n - 1$; and when the first summand is 2, there are $F(n - 1)$ ways to complete the counting for $n - 2$. Thus, in total, there are $F(n) + F(n - 1)$ ways to complete the counting for $n$.

[edit] Proof of the second identity

We count the number of ways summing 1's and 2's to $n + 1$ such that at least one of the summands is 2.

As before, there are $F(n + 2)$ ways summing 1's and 2's to $n + 1$ when $n \geq 0$. Since there is only one sum of $n + 1$ that does not use any 2, namely $1 + \ldots + 1$ ($n + 1$ terms), we subtract 1 from $F(n + 2)$.

Equivalently, we can consider the first occurrence of 2 as a summand. If, in a sum, the first summand is 2, then there are $F(n)$ ways to the complete the counting for $n - 1$. If the second summand is 2 but the first is 1, then there are $F(n - 1)$ ways to complete the counting for $n - 2$. Proceed in this fashion. Eventually we consider the $(n + 1)$th summand. If it is 2 but all of the previous $n$ summands are 1's, then there are $F(0)$ ways to complete the counting for 0. If a sum contains 2 as a summand, the first occurrence of such summand must take place in between the first and $(n + 1)$th position. Thus $F(n) + F(n - 1) + \ldots + F(0)$ gives the desired counting.
Proof of the third identity

This identity can be established in two stages. First, we count the number of ways summing 1s and 2s to −1, 0, …, or \(n + 1\) such that at least one of the summands is 2.

By our second identity, there are \(F(n + 2) - 1\) ways summing to \(n + 1\); \(F(n + 1) - 1\) ways summing to \(n\); …; and, eventually, \(F(2) - 1\) way summing to 1. As \(F(1) - 1 = F(0) = 0\), we can add up all \(n + 1\) sums and apply the second identity again to obtain

\[
[F(n + 2) - 1] + [F(n + 1) - 1] + … + [F(2) - 1] \\
= [F(n + 2) - 1] + [F(n + 1) - 1] + … + [F(2) - 1] + [F(1) - 1] + F(0) \\
= F(n + 2) + [F(n + 1) + … + F(1) + F(0)] - (n + 2) \\
= F(n + 2) + F(n + 3) - (n + 2).
\]

On the other hand, we observe from the second identity that there are

- \(F(0) + F(1) + … + F(n - 1) + F(n)\) ways summing to \(n + 1\);
- \(F(0) + F(1) + … + F(n - 1)\) ways summing to \(n\);

……

- \(F(0)\) way summing to −1.

Adding up all \(n + 1\) sums, we see that there are

- \((n + 1) F(0) + n F(1) + … + F(n)\) ways summing to −1, 0, …, or \(n + 1\).

Since the two methods of counting refer to the same number, we have

\[(n + 1) F(0) + n F(1) + … + F(n) = F(n + 2) + F(n + 3) - (n + 2)\]

Finally, we complete the proof by subtracting the above identity from \(n + 1\) times the second identity.

Identity for doubling \(n\)

Another identity useful for calculating \(F_n\) for large values of \(n\) is

\[F_{2n+k} = F_k F_{n+1}^2 + 2 F_{k-1} F_{n+1} F_n + F_{k-2} F_n^2\]

for all integers \(n\) and \(k\). Dijkstra[8] points out that doubling identities of this type can be used to calculate \(F_n\) using \(O(\log n)\) arithmetic operations.

(From practical standpoint it should be noticed that the calculation involves manipulation of numbers which length (number of digits) is \(\Theta(n)\). Thus the actual performance depends mainly upon efficiency of the implemented long multiplication, and usually is \(\Theta(n \log n)\) or \(\Theta(n \log^2 3)\).)

Other identities include relationships to the Lucas numbers, which have the same recursive properties but start with \(L_0=2\) and \(L_1=1\). These properties include \(F_{2n} = F_n L_n\).

There are also scaling identities, which take you from \(F_n\) and \(F_{n+1}\) to a variety of things of the form \(F_{an+b}\); for instance

\[F_{3n} = 5F_n^3 + 3(-1)^n F_n\]
These can be found experimentally using lattice reduction, and are useful in setting up the special number field sieve, should you wish to factorize a Fibonacci number. Their existence is strongly dependent on the fact that \( F_n = \sqrt{1/5 \left( \phi^n - (-\phi)^{-n} \right)} \); Fibonacci-like numbers with a less symmetrical form to the solution of the recurrence relation do not have such identities associated with them.

**[edit] Power series**

The generating function of the Fibonacci sequence is the power series

\[
s(x) = \sum_{k=0}^{\infty} F_k x^k.
\]

This series has a simple and interesting closed-form solution for \( x < 1/\sqrt{5} \)

\[
s(x) = \frac{x}{1 - x - x^2}.
\]

This solution can be proven by using the Fibonacci recurrence to expand each coefficient in the infinite sum defining \( s(x) \):

\[
s(x) = \sum_{k=0}^{\infty} F_k x^k
\]
\[
= F_0 + F_1 x + \sum_{k=2}^{\infty} (F_{k-1} + F_{k-2}) x^k
\]
\[
= x + \sum_{k=2}^{\infty} F_{k-2} x^k + \sum_{k=2}^{\infty} F_{k-2} x^k
\]
\[
= x + x \sum_{k=0}^{\infty} F_k x^k + x^2 \sum_{k=0}^{\infty} F_k x^k
\]
\[
= x + xs(x) + x^2 s(x)
\]

Solving the equation \( s(x) = x + xs(x) + x^2 s(x) \) for \( s(x) \) results in the closed form solution.

In particular, math puzzle-books note the curious value \( \frac{s\left(\frac{1}{10}\right)}{10} = \frac{1}{89} \), or more generally

\[
\sum_{n=1}^{\infty} \frac{F(n)}{10^{(k+1)(n+1)}} = \frac{1}{10^{2k+2} - 10^{k+1} - 1}
\]
for all integers $k \geq 0$.

Conversely,

$$\sum_{n=0}^{\infty} \frac{F_n}{k^n} = \frac{k}{k^2 - k - 1}.$$

[edit] Reciprocal sums

Infinite sums over reciprocal Fibonacci numbers can sometimes be evaluated in terms of theta functions. For example, we can write the sum of every odd-indexed reciprocal Fibonacci number as

$$\sum_{k=0}^{\infty} \frac{1}{F_{2k+1}} = \frac{\sqrt{5}}{4} \varphi_2^2 \left(0, \frac{3 - \sqrt{5}}{2}\right),$$

and the sum of squared reciprocal Fibonacci numbers as

$$\sum_{k=1}^{\infty} \frac{1}{F_k^2} = \frac{5}{24} \left(\varphi_2^4 \left(0, \frac{3 - \sqrt{5}}{2}\right) - \varphi_1^4 \left(0, \frac{3 - \sqrt{5}}{2}\right) + 1\right).$$

If we add 1 to each Fibonacci number in the first sum, there is also the closed form

$$\sum_{k=0}^{\infty} \frac{1}{1 + F_{2k+1}} = \frac{\sqrt{5}}{2}.$$

and there is a nice nested sum of squared Fibonacci numbers giving the reciprocal of the golden ratio,

$$\sum_{k=1}^{\infty} \frac{(-1)^{k+1}}{\sum_{j=1}^{k} F_j^2} = \frac{\sqrt{5} - 1}{2}.$$

Results such as these make it plausible that a closed formula for the plain sum of reciprocal Fibonacci numbers could be found, but none is yet known. Despite that, the reciprocal Fibonacci constant

$$\psi = \sum_{k=1}^{\infty} \frac{1}{F_k} = 3.359885666243\ldots$$

has been proved irrational by Richard André-Jeannin.

[edit] Primes and divisibility

Main article: Fibonacci prime

A Fibonacci prime is a Fibonacci number that is prime (sequence A005478 in OEIS). The first few are:

$$2, 3, 5, 13, 89, 233, 1597, 28657, 514229, \ldots$$
Fibonacci primes with thousands of digits have been found, but it is not known whether there are infinitely many. They must all have a prime index, except $F_4 = 3$.

Any three consecutive Fibonacci numbers, taken two at a time, are relatively prime: that is,

$$\gcd(F_n, F_{n+1}) = \gcd(F_n, F_{n+2}) = 1.$$  

More generally,

$$\gcd(F_n, F_m) = F_{\gcd(n, m)}.$$  [9]

A proof of this striking fact is online at Harvey Mudd College's Fun Math site.

[edit] Right triangles

Starting with 5, every second Fibonacci number is the length of the hypotenuse of a right triangle with integer sides, or in other words, the largest number in a Pythagorean triple. The length of the longer leg of this triangle is equal to the sum of the three sides of the preceding triangle in this series of triangles, and the shorter leg is equal to the difference between the preceding bypassed Fibonacci number and the shorter leg of the preceding triangle.

The first triangle in this series has sides of length 5, 4, and 3. Skipping 8, the next triangle has sides of length 13, 12 (5 + 4 + 3), and 5 (8 − 3). Skipping 21, the next triangle has sides of length 34, 30 (13 + 12 + 5), and 16 (21 − 5). This series continues indefinitely.

[edit] Magnitude of Fibonacci numbers

Since $F_n$ is asymptotic to $\varphi^n / \sqrt{5}$, the number of digits in the base $b$ representation of $F_n$ is asymptotic to $n \log_b \varphi$.

[edit] Applications

The Fibonacci numbers are important in the run-time analysis of Euclid's algorithm to determine the greatest common divisor of two integers: the worst case input for this algorithm is a pair of consecutive Fibonacci numbers.

Yuri Matiyasevich was able to show that the Fibonacci numbers can be defined by a Diophantine equation, which led to his original solution of Hilbert's tenth problem.

The Fibonacci numbers occur in the sums of "shallow" diagonals in Pascal's triangle and Lozanić's triangle (see "Binomial coefficient").

Every positive integer can be written in a unique way as the sum of one or more distinct Fibonacci numbers in such a way that the sum does not include any two consecutive Fibonacci numbers. This is known as Zeckendorf's theorem, and a sum of Fibonacci numbers that satisfies these conditions is called a Zeckendorf representation.

Fibonacci numbers are used by some pseudorandom number generators.

Fibonacci numbers arise in the analysis of the Fibonacci heap data structure.

A one-dimensional optimization method, called the Fibonacci search technique, uses Fibonacci numbers.[10]

In music, Fibonacci numbers are sometimes used to determine tunings, and, as in visual art, to determine the length or size of content or formal elements. It is commonly thought that the first
movement of Béla Bartók's *Music for Strings, Percussion, and Celesta* was structured using Fibonacci numbers.

Since the conversion factor 1.609344 for miles to kilometers is close to the golden ratio (denoted φ), the decomposition of distance in miles into a sum of Fibonacci numbers becomes nearly the kilometer sum when the Fibonacci numbers are replaced by their successors. This method amounts to a radix 2 number register in golden ratio base φ being shifted. To convert from kilometers to miles, shift the register down the Fibonacci sequence instead.[11][12][13]

**[edit] Fibonacci numbers in nature**

Sunflower head displaying florets in spirals of 34 and 55 around the outside

Fibonacci sequences appear in biological settings,[14] such as branching in trees, the fruitlets of a pineapple,[15] an uncurling fern and the arrangement of a pine cone.[16] In addition, numerous poorly substantiated claims of Fibonacci numbers or golden sections in nature are found in popular sources, e.g. relating to the breeding of rabbits, the spirals of shells, and the curve of waves[citation needed].

Przemyslaw Prusinkiewicz advanced the idea that real instances can be in part understood as the expression of certain algebraic constraints on free groups, specifically as certain Lindenmayer grammars.[17]

A model for the pattern of florets in the head of a sunflower was proposed by H. Vogel in 1979.[18] This has the form

\[ \theta = \frac{2\pi}{\phi^2 n}, \quad r = c\sqrt{n} \]

where \( n \) is the index number of the floret and \( c \) is a constant scaling factor; the florets thus lie on Fermat's spiral. The divergence angle, approximately 137.51°, is the golden angle, dividing the circle in the golden ratio. Because this ratio is irrational, no floret has a neighbor at exactly the same angle from the center, so the florets pack efficiently. Because the rational approximations to the golden ratio are of the form \( F(j):F(j+1) \), the nearest neighbors of floret number \( n \) are those at \( n\pm F(j) \) for some index \( j \) which depends on \( r \), the distance from the center. It is often said that sunflowers and similar arrangements have 55 spirals in one direction and 89 in the other (or some other pair of adjacent Fibonacci numbers), but this is true only of one range of radii, typically the outermost and thus most conspicuous.[19]

**[edit] Popular culture**

*Main article: Fibonacci numbers in popular culture*

Because the Fibonacci sequence is easy for non-mathematicians to understand, there are many examples of the Fibonacci numbers being used in popular culture.
**[edit]** Generalizations

*Main article: Generalizations of Fibonacci numbers*

The Fibonacci sequence has been generalized in many ways. These include:

- Extending to negative index $n$, satisfying $F_n = F_{n-1} + F_{n-2}$ and, equivalently, $F_{-n} = (-1)^n F_n$.
- Generalising the index from positive integers to real numbers using a modification of Binet's formula. [20]
- Starting with other integers. Lucas numbers have $L_1 = 1$, $L_2 = 3$, and $L_n = L_{n-1} + L_{n-2}$.
- Primefree sequences use the Fibonacci recursion with other starting points in order to generate sequences in which all numbers are composite.
- Letting a number be a linear function (other than the sum) of the 2 preceding numbers. The Pell numbers have $P_n = 2P_{n-1} + P_{n-2}$.
- Not adding the immediately preceding numbers. The Padovan sequence and Perrin numbers have $P(n) = P(n-2) + P(n-3)$.
- Generating the next number by adding 3 numbers (tribonacci numbers), 4 numbers (tetranacci numbers), or more.
- Adding other objects than integers, for example functions or strings.

**[edit]** Numbers Properties

**[edit]** Divisibility by 11

\[
\sum_{k=n}^{n+9} F_k = 11F_{n+6}
\]

**[edit]** Periodicity of last n digits

One property of the Fibonacci numbers is that the last $n$ digits have the following periodicity:

- $n = 1 : 60$
- $n = 2 : 300$
- $n = 3 : 1500$
- $n = 4 : 15000$
- $n = 5 : 150000$

Mathematician Dov Jarden proved that for $n$ greater than 2 the periodicity is $15 \cdot 10^{n-1}$. [citation needed]

**[edit]** Pythagorean triples

Any four consecutive Fibonacci numbers $F_n$, $F_{n+1}$, $F_{n+2}$ and $F_{n+3}$ can be used to generate a Pythagorean triple:

\[
a = F_n F_{n+3} ; \quad b = 2F_{n+1}F_{n+2} ; \quad c = F_{n+1}^2 + F_{n+2}^2 ; \quad a^2 + b^2 = c^2.
\]

Example 1: let the Fibonacci numbers be 1, 2, 3 and 5. Then:

\[
a = 1 \times 5 = 5
\]
\[ b = 2 \times 2 \times 3 = 12 \]
\[ c = 2^2 + 3^2 = 13 \]
\[ 5^2 + 12^2 = 13^2 \]

Example 2: let the Fibonacci numbers be 8, 13, 21 and 34. Then:
\[ a = 8 \times 34 = 272 \]
\[ b = 2 \times 13 \times 21 = 546 \]
\[ c = 13^2 + 21^2 = 610 \]
\[ 272^2 + 546^2 = 610^2 . \]

[edit] See also

- Logarithmic spiral
- Fibonacci number program at Wikibooks
- The Fibonacci Association
- Fibonacci Quarterly — an academic journal devoted to the study of Fibonacci numbers
- Negafibonacci numbers

[edit] References

2. ^ Parmanand Singh,"The So-called Fibonacci numbers in ancient and medieval India.
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   Sciences.
5. ^ The Fibonacci Numbers and the Ancestry of Bees
   92. ISBN 0198581203. Strena seu de Nive Sexangula (1611)
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11. ^ An Application of the Fibonacci Number Representation
12. ^ A Practical Use of the Sequence
13. ^ Zeckendorf representation
    532.
17. ^ Prusinkiewicz, Przemyslaw; James Hanan (1989). Lindenmayer Systems, Fractals, and
18. ^ Vogel, H (1979), "A better way to construct the sunflower head", Mathematical
    Biosciences (no. 44): 179–189
[edit] External links

- Donald E. Simanek, *Fibonacci Flim-Flam*, (undated, 2005 or earlier).
- Rachel Hall, *Hemachandra's application to Sanskrit poetry*, (undated; 2005 or earlier).
- (no author given), *Fibonacci Numbers Information*, (undated, 2005 or earlier).
- *Fibonacci Numbers and the Golden Section* – Ron Knott's Surrey University multimedia web site on the Fibonacci numbers, the Golden section and the Golden string.
- The *Fibonacci Association* incorporated in 1963, focuses on Fibonacci numbers and related mathematics, emphasizing new results, research proposals, challenging problems, and new proofs of old ideas.
- Dawson Merrill's *Fib-Phi* link page.
- *Fibonacci primes*
- *The One Millionth Fibonacci Number*
- *The Ten Millionth Fibonacci Number*
- An *Expanded Fibonacci Series Generator*
- Manolis Lourakis, *Fibonacci search in C*
- *Scientists find clues to the formation of Fibonacci spirals in nature*
- *Fibonacci Numbers* at *Convergence*
- *Online Fibonacci calculator*

Fibonacci numbers in popular culture

From Wikipedia, the free encyclopedia

The Fibonacci numbers form a sequence of integers, mathematically defined by:
\[ F(0) = 0; F(1) = 1; F(n) = F(n - 1) + F(n - 2) \text{ for } n > 1 \]

So after the two initial numbers, each number is the sum of the two preceding numbers:
0, 1, 1, 2, 3, 5, 8, 13, 21, 34, ...

This concept is easily understood by non-mathematicians and has appeared many times in popular culture. Fibonacci numbers have for example been mentioned in novels, films, episodes of television shows, and songs. They have also been used in the creation of music and visual art.

[edit] Architecture
- The sequence has been used in the design of a building, the Core, at the Eden Project, near St Austell, Cornwall, England.

[edit] Cinema
- Referenced in the film Dopo Mezzanotte (After Midnight) where the sequence appears as neon numbers on the dome of the Mole Antonelliana in Turin, Italy and is also used to select numbers in a lottery, ultimately winning it.
- Along with the concepts of the golden rectangle and golden spiral, the fibonacci sequence is used in Darren Aronofsky's independent film π (1998)
- Referenced in the film of The Phantom Tollbooth.

[edit] Literature
- The Fibonacci sequence plays a small part in the bestselling novel and film The Da Vinci Code.
- The Fibonacci sequence plays a part in unravelling the Atlantis Code in Stel Pavlou's bestselling novel Decipher.
- Fibs (poems of a specific form as per the fibonacci sequence) have been popularized by Gregory K. Pincus on his blog, Gottabook.
- The sequence features prominently in the poems "This is Genius" and "One Must Wonder" by Canadian Artist and Poet Derek R. Audette.
- A part of the Fibonacci sequence is used as a code in Matthew Reilly's novel Ice Station.
• The sequence is used in the novel *The Wright 3* by Blue Balliett.
• In Philip K. Dick's novel *VALIS*, the Fibonacci sequence (as well as the Fibonacci constant) are used as identification signs by an organization called the "Friends of God".
• In the collection of poetry *alfabet* by the Danish poet Inger Christensen, the Fibonacci sequence is used to define the number of lines in each poem.
• The Fibonacci sequence is one of many mathematical topics in Scarlett Thomas's novel *PopCo* whose main character has an affinity for mathematics.
• The Fibonacci sequence is one of the main sources of math-based magic for the main character, Reason Cansino, in Justine Larbalestier's trilogy, *Magic or Madness*.

[edit] Music

• MC Paul Barman structured the rhymes in his song "Enter Pan-Man" according to the Fibonacci sequence. [1]
• BT released a dance song in 2000 entitled "Fibonacci Sequence," which features a sample of a reading of the sequence over a frenetic breakbeat. He also used the Fibonacci sequence as a compositional structure in his 2006 album *This Binary Universe*.
• Tool's song "Lateralus" from the album of the same name features the Fibonacci sequence symbolically in the verses of the song. The syllables in the first verse count 1, 1, 2, 3, 5, 8, 5, 3, 13, 8, 5, 3. The missing section (2, 1, 2, 3, 5, 8) is later filled in during the second verse. [1]
• The ratios of justly tuned octave, fifth, and major and minor sixths are ratios of consecutive Fibonacci numbers.
• Ernő Lendvai analyzes Béla Bartók's works as being based on two opposing systems, that of the golden ratio and the acoustic scale. [2] In the third movement of Bartok's *Music for Strings, Percussion and Celesta*, the opening xylophone passage uses Fibonacci rhythm as such: 1:1:2:3:5:8:5:3:2:1:1. [3]
• French composer Erik Satie used the golden ratio in several of his pieces, including *Sonneries de la Rose+Croix*. His use of the ratio gave his music an otherworldly symmetry.
• The Fibonacci numbers are also apparent in the organisation of the sections in the music of Debussy's *Image, Reflections in Water*; in which the sequence of keys is marked out by the intervals 34, 21, 13 and 8. [3]
• American composer Casey Mongoven has developed a style of music characterized by the Fibonacci numbers and the golden ratio.
• A song from the Clock Radio service by They Might Be Giants entitled *Turtle Songs of North America* describes to a fictional Tudlow Turtle whose 'gasping' mating call follows the Fibonacci sequence, causing it to pass out after making as many as 55 or 89 gasps.

[edit] Television

• The Fibonacci sequence is a key plot point in the television show *Mathnet*'s episode "The Case of the Willing Parrot."
• The Fibonacci sequence is also referenced to in *NUMB3RS*, the television series. Many times the cast reference note the relationship the sequence has with nature to further emphasise the wonders of mathematics.
• It was also used as a key plot point in an episode of the *Disney Channel* original television series *So Weird*.
• Used in Steven Spielberg's miniseries *Taken*.
• Used in the British series *Eleventh Hour*’s episode "Kryptos." The Fibonacci sequence in sea shells is used as part of the evidence for Earth facing a runaway greenhouse effect due to global warming.
[edit] Visual arts

- In a FoxTrot comic, Jason and Marcus are playing football. Jason yells, "Hut 0! Hut 1! Hut 1! Hut 2! Hut 3! Hut 5! Hut 8! Hut 13!" Marcus yells, "Is it the Fibonacci sequence?" Jason says, "Correct! Touchdown, Marcus!"
- Marilyn Manson uses the sequence overtly in a watercolor painting entitled Fibonacci during his Holy Wood era, which uses bees as focal points. More discreetly, Manson used the sequence in the interior album art of Antichrist Superstar in his depiction of "The Vitruvian Man", in the vein of Leonardo DaVinci's work which was also based on the sequence. There is also speculation that some of the beats in the songs on the album Holy Wood (In the Shadow of the Valley of Death) are based on the Fibonacci sequence.
- Mario Merz frequently uses the Fibonacci sequence in his art work.
- Valerie Page uses a Fibonacci geometric pattern in her quilted works of art. PageQuilts.com
- Fibonacci numbers have also been used in knitting to create visually appealing patterns. [2]
- Fibonacci numbers are referenced in the online comic xkcd [3].

[edit] Games

- The Fibonacci numbers are used for a variety of purposes in the Earthdawn role playing game.
- In the MMORPG Runescape quest "The Feud," the sequence is the solution to the locked safe in the Mayor's house.
- In the Doom RPG for mobile phones, the first seven digits in the sequence are used to gain access to a secret room near the end of the game.

[edit] See also

- Golden ratio

[edit] References


[edit] External links

- Alexey Stakhov, Museum of Harmony and Golden Section, (undated, 2005 or earlier).
- Math for Poets and Drummers - Rachael Hall surveys rhythm and Fibonacci numbers and also the Hemachandra connection. Saint Joseph's University, 2005.
- Rachel Hall, Hemachandra's application to Sanskrit poetry, (undated; 2005 or earlier).
Phi and the Fibonacci Series

**Leonardo Fibonacci discovered the series which converges on phi**

In the 12th century, Leonardo Fibonacci discovered a simple numerical series that is the foundation for an incredible mathematical relationship behind phi. Starting with 0 and 1, each new number in the series is simply the sum of the two before it.

\[
0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, \ldots
\]

The ratio of each successive pair of numbers in the series approximates phi \((1.618. . .)\), as 5 divided by 3 is 1.666..., and 8 divided by 5 is 1.60.

The table below shows how the ratios of the successive numbers in the Fibonacci series quickly converge on Phi. After the 40th number in the series, the ratio is accurate to 15 decimal places.

\[
1.618033988749895 \ldots
\]

**Compute any number in the Fibonacci Series easily!**

Here are two ways you can use phi to compute the nth number in the Fibonacci series \((f_n)\).

If you consider 0 in the Fibonacci series to correspond to \(n = 0\), use this formula:

\[
f_n = \Phi^n / 5^{1/2}
\]

Perhaps a better way is to consider 0 in the Fibonacci series to correspond to the 1st Fibonacci number where \(n = 1\) for 0. Then you can use this formula, discovered and contributed by Jordan Malachi Dant in April 2005:

\[
f_n = \Phi^n / (\Phi + 2)
\]

Both approaches represent limits which always round to the correct Fibonacci number and approach the actual Fibonacci number as \(n\) increases.

**The ratio of successive Fibonacci numbers converges on phi**

<table>
<thead>
<tr>
<th>Sequence in the series</th>
<th>Resulting Fibonacci number (the sum of the two numbers before it)</th>
<th>Ratio of each number to the one before it (this estimates phi)</th>
<th>Difference from Phi</th>
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</thead>
</table>

...
<table>
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<th>\phi_n</th>
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</tr>
</tbody>
</table>

Tawfik Mohammed notes that 13, the unlucky number, is found at position number 7, the lucky number!
Bio-Energetic Frequency Charts

[Editor's Note: This is one of many possible frequency lists that can be used with the NCH Tone Generator. How you get these waves into the body makes a difference as to how well they will work. The NCH Tone Generator is using the speakers or headphones plugged into your computer and you are listening to audio waves. Audio waves aren't as effective as plasma or radio frequency radiations, but they do work. Combining this sound therapy with light therapy will enhance its performance. The volume of the tones do not have to be loud; just enough to hear it. The number(s) you see next to the condition is the frequency number you should set on the generator. Just place our cursor over the numbers shown on the NCH Generator and type in new ones].

Frequency Chart I

(Please note that although most of the frequencies in this list are derived from homeopathic nosodes [vaccines], allergens, sarcodes [organ therapy preparations], or cell salts, some are directly from the specified ailment or substance. However, this distinction appears inconsequential since bio-energetic frequencies should be effective in either case.)

Actinobacillus (potentially pathogenic bacteria normally found in mammals): 773
Actinomyces israelii (a bacterium normally found in the bowel and throat that causes deep, pus-filled holes in tissue): 222, 262, 2154
Adnexitis (swelling of the ovaries or Fallopian tubes): 440, 441, 522, 572, 3343, 3833, 5312
Adenoma, cervical (epithelial tumor of the cervix that can be either benign or malignant): 433
Adenovirus (a virus that causes infections in the lungs, stomach, and intestines): 333, 523, 788
Aflatoxin (a liver-damaging toxin produced by certain food molds): 344, 510, 943
AIDS: 1.2, 1550, 1500
Kaposi's sarcoma: 249, 418
Altenaria tenuis (a fungus associated with lung ailments): 853
Amoeba (a single-celled, sometimes-infectious microorganism): 310, 333, 532, 732, 827, 1522
Amoeba hepar abscess (liver abscess caused by amoebic infection): 344
Anthracinum (homeopathic anthrax nosode): 633
Aremes tennus: 667
Arnica (a healing herb): 1042
Arsenic alb. (homeopathic cell salt): 562
Aspergillus flavus (mold found on corn, peanuts, and grain that produces aflatoxin): 1823
Aspergillus glaucus (blue mold occurring in some human infectious processes): 524
Aspergillus niger (common mold that may produce severe and persistent infection): 374
Aspergillus terreus (mold occasionally associated with infection of the bronchi and lungs): 743
Asthma: 1233, 1283
Astrocytoma (common tumor of brain and central nervous system): 857
Bacillus subtilis (homeopathic nosode from a bacterium that can cause conjunctivitis): 432, 722,
Bacillinum (homeopathic nosode): 132, 423, 432, 785, 853, 854, 921, 1027, 1042, 1932

Bacterium lactis nosode (homeopathic): 512, 526, 798, 951, 5412

Bacterium coli (a type of E. coli normally found in the intestines, water, milk, and soil that is the most frequent cause of urinary-tract infections and a common cause of wound infection): 642

Bacterium coil commune (E. coli) combination: 282, 333, 413, 957, 1320, 1722

Bakers' yeast (homeopathic preparation for an allergen): 775

Back Pain 41.2

Banti's syndrome (A serious ailment in which blood vessels between the intestines and the liver become blocked, leading to congestion of the veins, an enlarged spleen, bleeding of the stomach and intestines, cirrhosis of the liver, and blood cell destruction.): 1778

Barley smut (homeopathic preparation for an allergen): 377

Bermuda smut (homeopathic preparation for an allergen): 971

Biliary cirrhosis (an inflammatory condition in which bile flow through the liver is obstructed): 381, 514, 677, 2271

Bilirubin (a bile pigment that may result in jaundice in high concentrations): 717, 726, 731, 863

Bladder TBC: 642, 771

Blastocystis hominus: 365, 595, 844, 848, 1201, 1243

Blue cohosh (a healing herb): 364

Borrelleosis (Lyme disease, relapsing fever in humans and animals caused by parasitic spirochetes from ticks): 254, 345, 525, 605, 644, 673, 797, 884, 455

Botrytis cinerea (a homeopathic preparation from a fungal allergen): 1132

Botulinum (a bacillus that causes an often fatal form of food poisoning) 518, 533

Brain tumors:

1) Astrocystoma (common tumor of brain and central nervous system): 857
2) Gliomas (largest group of brain cancers): 543, 641

Branhamella (Moraxella) catarrhalis: 2013

Bronchial: 462, 852, 1582

Bronchiectasis (chronic dilatation of the bronchi): 342

Bronchopneumonia borinum (a form of bronchial pneumonia): 452, 1474

Brucella abortus (undulent fever or Bang's bacillus, found in cattle): 1423

Brucella melitensis (form of Brucella found in goats and sheep): 748

Campylobacter (bacteria causing sudden infectious diarrhea in newborns): 732, 1633, 1834, 2222

Cancer: 2008, 6.8, 440

1) Adenoma, cervical: 433
2) Astrocystoma (common tumor of brain and central nervous system): 857

3) Bronchial: 462, 852,1582
4) Colon: 656
5) **Fibrosarcoma** (develops rapidly from small bumps on the skin): 1744

6) **Gliomas** (largest group of brain cancers): 543, 641

7) **Hodgkin's disease** (a cancer of the lymphatic system that is both chronic and progressive): 552, 1522

8) **Kaposi's sarcoma**: 249, 418

9) **Leukemia** (starts with the bone marrow but eventually involves all body organs):

10) **Feline Leukemia** (cat): 424, 830, 901, 918

11) "**Hairy cell**" (typified by abnormal blood cells & shortage of others): 122, 622, 932, 5122

12) **Lymphatic**: 478, 833

13) **Mycloid** (characterized by rapid growth of incompletely-formed white blood cells): 422, 822

14) **T-cell**: 222, 262, 822, 3042, 3734

15) **Mycosis fungoides** (a form of skin cancer resembling eczema): 852

16) **Plasmacytoma** (plasmacell tumor): 475

17) **Liver**, fermentative: 214

18) **Uterine**, fermentative: 127

**Candida** (a genus of yeastlike fungi normal to the human body but capable of harmful overgrowth): 866

**Tropicalis**: 1403

**Canine parvovirus**: 185, 323, 562, 613, 622, 1000, 4027

*mutant strain*: 323, 514

*type B*: 323, 535, 613, 755

**Carbo animalis** (homeopathic remedy from animal-bone charcoal): 444

**Carcinoma** (any cancerous tumor starting with cells covering body organ surfaces that then invade both local and distant areas)

1) **Colon**: 656

2) **Liver**, fermentative: 214

3) **Uterine**, fermentative: 127

**Carvularia spirafera**: 879

**Cataract**

*Brunescent* (brown opacity in later life): 2010, 1335, 1830 complicated (secondary type caused by disease, degeneration, or surgery): 496

**Causticum** (a homeopathic remedy): 540, 1013

**Celia carroll**: 576, 973
Cephalosporium (fungi that are the source of some broad-spectrum antibiotics): 481, 3966

Cerumen (ear wax): 311, 320, 750, 984

Cervix adenoma (epithelial tumor of the cervix): 433

Chaetomium globosum: 221, 867

Chemicals:
1) Methotrexate: 584
2) Green dye: 563, 2333

Chicken pox: 787, 3343

Chlamydia (a sexually-transmitted bacterial infection): 430, 620, 624, 840, 2213

Cholera (an extremely contagious and serious bacterial infection of the small intestines): 330, 843, 844, 1035

Cholecystitis
1) Acute (excruciating gallstone attack): 481, 743, 865, 928
2) Chronic (long-term inflammation of the gallbladder): 432

Cholesteatoma (benign tumor usually found in middle ear & mastoid region): 453, 618, 793

Cimicifuga (plant family including black snakeroot and black cohosh): 594

Cirrhosis, biliary (an inflammatory condition in which bile flow through the liver is obstructed): 381, 514, 677, 2271

Cladosporium fulvum (a pathogenic fungus): 438

Coelicia: 154, 594, 656

Condylomata (venereal warts caused by infectious papilloma virus): 466

Corn smut (homeopathic preparation for an allergen): 546, 1642

Coxackie virus (produces disease resembling non-paralytic polio): 136, 144, 232, 380, 422, 424, 435, 921, 923
1) type B1: 834
2) type B2: 705, 534
3) type B4: 421
4) type B5: 462, 1043, 1083
5) type B6: 736, 814

Cytomegalovirus (CMV) (known as salivary gland virus or human herpes type 5): 126, 597, 1045, 2145

Crinis humansis: 646
1) Critter 1: 1033
2) Critter 2: 421, 1035, 1111

Crocus sotillus: 710

Cryptosporidium (parasitic protozoa infrequently causing diarrhea in humans): 482, 575, 4122

Cyst, ovarian: 982

Cystic fibrosis (Also called mucoviscidosis, this is an inherited disorder of the exocrine glands that
causes them to release very thick mucus): 523

Cystitis, chronic (long-term inflammation of the urinary bladder and ureters): 246

Cystopyelonephritis (inflammation from bladder to kidney): 1385

Dermatium nigrum (soil fungi found in human lesions): 243

Dental: 635, 640, 1036, 1043, 1094

Diphtherinum (homeopathic nosode for diphtheria): 624

Distemper: 242, 254, 312, 442, 551, 573, 624, 671, 712, 940, 1269, 1950

Diverticulosis (characterized by tiny hernias of intestinal tissue protruding through the muscular wall of the colon): 154, 934

Drogioma (a brain tumor): 853

E. coli (Escherichia coli; a major cause of infections in wounds and the urinary tract): 282, 333, 413, 957, 1320, 1722

Ear wax: 311, 320, 750, 984

Echinococcinum (homeopathic remedy for tapeworms found in dogs, wolves, cats, & rodents that can infect man): 164, 453, 542, 623

Echo virus (causes a type of meningitis): 620

Encephalitis (inflammation of the tissues of the brain and spinal cord): 841

Endometriosis, chronic (growth of uterine tissue outside the uterus that may cause pain, infertility, & abnormal uterine bleeding): 246

Entamoeba histolytica (highly damaging protozoa causing dysentary and liver infection): 148, 166, 308

Enterobasiasis (intestinal worms frequently found in children): 773, 827, 835, 4152

Enterococcinum (homeopathic nosode for Strep-family organisms found in the digestive and urinary tracts): 686

Epicoccum: 734

Epidermophyton floccinum (homeopathic remedy for fungus that attacks skin & nails, includes athlete's foot): 644, 766

Epstein-Barr virus (the herpes virus causing mononucleosis): 105, 172, 253, 660, 663, 669, 744, 825, 1032, 1920

Erysipelas (a human bacterial infection manifesting in the skin and possibly related to the swine form of the disease): 616, 845

Escherichia coli (E. coli; a major cause of infections in wounds and the urinary tract): 282, 333, 413, 957, 1320, 1722

Fasciola hepatica (liver fluke of herbivorous animals occasionally found in humans): 143, 275

Febris wolhynia (a Rickettsia illness, transmitted by lice, that is debilitating and conducive to relapse): 547

Feline (cat) leukemia: 424, 830, 901, 918

Fell: 435

Felis: 430, 834, 2232, 3233
Fel tauri (homeopathic preparation of ox bile): 672

Fibrosarcoma (malignancy containing connective tissue and developing rapidly from small bumps on the skin): 1744

Fibroadenoma mamanae (non-cancerous, fibrous nodules in the breasts): 1384

Filariose: (thread-like worms that invade body tissues and cavities): 112, 120

Fischpyrogen: 832

Fistula Dentalis: 550, 727, 844, 1122

FIV: 262, 323, 372, 404, 567, 712, 742, 760, 773, 916, 1103, 1132, 3701

Flu
1) ’78: 844
2) ’79: 123
3) ’83: 730, 734
4) ’89: 216, 322
5) ’93: 254, 522, 615, 850
6) Triple nosode: 421, 632, 1242, 1422, 1922, 3122
7) Virus "A": 332
8) Virus "A, Port Chalmers": 332
9) Virus "B": 530, 532, 536, 537
8) Virus "B, Hong Kong": 555
9) Virus "British": 932
10) "Spanish": 462
11) "Swine": 413, 432, 663, 839, 995

Flukeworm (parasitic flatworms, including tapeworms, that invade many body areas): 524, 854

Fluor Alb (homeopathic cell salt): 110, 420, 423, 424, 502, 2222

Follicular mange (contagious dermatitis found in many animals that is caused by mites and in which the principle activity is at the hair follicles): 253, 693

Foot & mouth syndrome (a mild viral infection found in young children): 232, 237, 1214, 1243, 1244, 1271, 5411

Fungus flora: 632

Fusarium oxysporum (a fungus causing inflammation of the cornea of the eye): 102, 705

Gallbladder inflammation (chronic): 432

Gallstone attack: 481, 743, 865, 928

Ganglionitis, acute posterior (commonly known as shingles or herpes zoster): 574, 1557

Gardnerella (bacteria that often infect and inflame the vaginal mucosa): 320, 782

Geotrichum candidum (fungus found in feces and dairy products whose manifestations resemble those of candida): 412, 543

German measles (rubella or 3-day measles): 510, 517

Giardia (an intestinal parasite, also known as lamblia, spread by contaminated food and water and
by human-to-human contact): 334

**Gliocladium** (brain fungus): 855

**Gliomas** (largest group of brain cancers): 543, 641

**Grippe** (influenza): 343, 500, 512, 541, 862, 1000, 1192, 3012, 3423, 10223

1) '86 *tri*: 532
2) '87: 332, 953
3) '88: 2050
4) '89: 353
5) '90: 656

**Haemophilia** (hereditary bleeding disorders in which the blood does not readily clot): 845

**Haemophilus influenzae**: 542

1) *type B*: 652, 942

**Hair, human**: 646

**Hand, foot, & mouth syndrome** (a mild viral infection found in young children): 232, 237, 1214, 1243, 1244, 1271, 5411

**Heartworm**: 543, 2322

**Helminthosporium** (the reproductive element of parasitic worms): 793, 969

**Hemobartonella felis**: 603, 957

**Hemorrhoid**: 447

**Hepatitis** (inflammation of the liver): 224, 317, 1351

1) *Type A*: 321, 3220
2) *Type B*: 433 new numbers: 477, 922
3) *Type C* (also known as "non-A, non-B"): 166

**Herpes**

1) *Simplex* (primarily non-genital): 322, 343, 476, 822, 843, 1043, 1614, 2062
2) *Simplex II* (primarily genital): 556, 832
3) *Simplex IU.2*: 808
4) *Type 2A*: 532
5) *Type C*: 395, 424, 460, 533, 554, 701, 745, 2450
6) *Type 5*: 126, 597, 1045, 2145
7) *Zoster* (shingles): 574, 1557

**Hirudo medicinalis** (a homeopathic remedy prepared from a leech used for therapeutic purposes): 128

**HIV**: 683, 714, 3554

**Hodgkin's disease** (a form of malignancy characterized by enlargement of the lymph nodes, spleen, and lymph tissue and often includes weight loss, fever, night sweats, and anemia): 552, 1522

**Hormodendrum** (a genus of fungi that includes human pathogens): 695

**Household insect mix**: 723
Icterus, haemolytic (a chronic form of jaundice involving anemia): 243
Influencinum Berlin '55: 430, 720, 733
InfluencinumVesic: 203, 292, 612, 975
InfluencinumVesic NW: 364, 519, 590
InfluencinumVesic SW: 433
Influenzum, Bach poly flu (homeopathic): 122, 350, 487, 634, 823
Influenzum toxicum (homeopathic): 854
Influenza
1) *Triple nosode*: 421, 632, 1242, 1422, 1922, 3122
2) *Virus "A"*: 332
3) *Virus "A, Port Chalmers"*: 332
4) *Virus "B":* 530, 532, 536, 537
5) *Virus "B, Hong Kong":* 555
6) *Virus "British":* 932
7) "Spanish": 462
8) "Swine": 413, 432, 663, 839, 995
Intestinal inflammation: 105, 791
JGE: 322, 1000
Kaposi's sarcoma: 249, 418
Kidney papilloma (small, supposedly-benign growth on a kidney): 110, 767, 917
Kieferosteitis (a type of bone inflammation marked by enlargement and pain): 432, 516
Klebsiella pneumoniae (the bacterium causing acute, bacterial pneumonia): 412, 766
Lac Deflorat: 230, 371
Lamblia (an intestinal parasite, also known as Giardia, spread by contaminated food and water and by human-to-human contact): 334
Lateral sclerose (degeneration of spinal cord leading to spastic paraplegia): 254
Legionella (homeopathic remedy for Legionnaires' disease, a gram-negative bacteria associated with condensed or treated water that migrate to lung tissue and stimulate severe respiratory manifestations): 723
Leishman Donovan bodies (a type of pathogenic, human parasite found worldwide): 525
Leptospirosis P. C. (a disease that is spread to humans through animal urine or things contaminated by it and that can cause meningitis, jaundice, anemia, miscarriage, and death): 612
Leukoencephalitis (a serious, progressive brain disease): 324, 572, 932, 1035, 1079, 1111, 1160, 1333, 1630
Leukemia (cancer involving the blood-forming tissues in bone marrow)
1) *feline (cat)*: 424, 830, 901, 918
2) "*Hairy cell"* (characterized by abnormal blood cells & shortage of others): 122, 622, 932, 5122
3) *Lymphatic*: 478, 833
4) *Mycloid*: 422, 822
5) T-cell: 222, 262, 822, 3042, 3734

**Leukoencephalitis** (inflammation of brain's white matter, usually in infants and children, but also found in horses as a result of forage poisoning): 324, 572, 932, 1035, 1079, 1111, 1160, 1333, 1630

**Leukose** (proliferation of tissues that form white blood cells; considered to be foundational stage of leukemia): 612, 633, 653, 3722, 41224

**Lipoma** (benign, soft tumor of fatty tissue): 47

**Listeriose** (a serious disease causing miscarriage, meningitis, and endocarditis in humans; known as "circling disease in ruminants and causes liver necrosis in animals with single stomachs): 471, 774, 2162

**Living sinus bacteria:** 548

**Luesinum/Syphilinum** (a homeopathic remedy for syphilis): 177

Lupus (localized degeneration of skin by various diseases; vulgaris is a common form of this ailment that is actually a rare form of tuberculosis that manifests with disfigurement and destruction of the skin and cartilage of the face) 205, 243, 244, 352, 386, 633, 921, 942, 993, 1333, 1464

**Lyme disease** (also known as borreliosis; relapsing fever in humans and animals caused by parasitic spirochetes from ticks): 254, 345, 525, 605, 644, 673, 797, 884, 1455

**Lymphangitis** (lymphatic vessel inflammation of humans and horses most commonly caused by strep but also by other bacteria, yeast fungus, and cancer): 574, 1120

**Lymphogranuloma** (Hodgkin's disease; a form of malignant lymphoma): 552, 1522

**Lyssinum** (a homeopathic nosode for rabies): 547, 793

Malaria (an infectious disease, originating in tropical areas, that is transmitted by a mosquito bite and characterized by fever, anemia, and spleen enlargement): 222, 550, 713, 930, 1032, 1433

Mallei: 1273

**Mamma fibromatosis** (formation of fibroid tumors of the breasts): 267

**Mannan:** 961

**Mange, follicular** (contagious dermatitis found in many animals that is caused by mites and in which the principle activity is at the hair follicles): 253, 693

**Marsh elder:** 474

**Mastitis** (an inflamed breast usually caused by bacterial infection): 654

**Mastoiditis** (inflammation of the bony structure of the head in the region of the ears below the eyes): 287

**Measles**

1) **Rubella** (German or 3-day measles): 431, 510
2) **Rubella vaccine:** 459
3) **Rubeola** (9-day measles): 342, 467, 520, 1489
4) **Rubeola vaccine:** 962

**Medorrhinum** (homeopathic nosode for urethral discharge): 230, 442, 554, 843, 854, 1700, 1,2222

**Melanoma metastasis:** 979

**Meningococcus virus** (a virus infecting the membranes that envelop the brain and spinal cord): 720
Meningioma (a benign, slow-growing tumor of the membranes that envelop the brain and spinal cord): 535

Meningitis (inflammation of the membranes that envelop the brain and spinal cord): 322, 733, 822, 1044, 1422

Meningococcinum (homeopathic nosode for meningitis): 130, 517, 676, 677

Microsporum audouinii (a fungus commonly causing ringworm of the scalp): 422, 831, 1222

Canis (a fungus causing ringworm in cats, dogs, and children): 1644

Mold: 222, 242, 523, 565, 592, 623, 745, 933, 1130, 1155, 1333, 1833, 4442

A&C: 331, 732, 923, 982
1) Mix A: 594
2) Mix B: 158, 512, 623, 774, 1016, 1463
3) Mix C: 391, 1627
4) Vac II: 185, 257

Monilia (the former name for Candida): 866, 886

Monotospora languinosa (homeopathic remedy for fungal allergen): 788

Morbus Parkinson (Parkinson's disease; A slowly progressive, degenerative, neurologic disorder): 813

Morgan (bact): 778

Mucocutan Perniciosis: 833

Mucoviscidosis (Also called cystic fibrosis, this is an inherited disorder of the exocrine glands that causes them to release very thick mucus): 523

Mucor (a genus of fungi)
1) Mucedo (causes rot in fruit and baked goods & sometimes found on feet and skin): 612, 1000
2) Plumbeus: 361
3) Racemosis simus (grows on decaying vegetation and bread and causes ear infection): 310, 474

Mucormycosis (also called zygomycosis; a serious, fungal infection usually associated with uncontrolled diabetes mellitus or immunosuppressive drugs): 942

Mumps (acute viral inflammation of the saliva glands): 152, 190, 235, 242, 516, 642, 674, 922, 1243, 1660, 2630, 3142

Mumps vaccine: 273, 551, 711, 730, 1419

Muscular dystrophy (inherited disorders characterized by weakness and progressive wasting of skeletal muscles despite no concomitant wasting of nerve tissue): 153

Mycloid leukemia (characterized by rapid growth of incompletely-formed white blood cells): 422, 822

Mycogone spp (homeopathic allergenic preparation based on fungus): 371, 446, 1123

Mycosis fungoides (a form of skin cancer resembling eczema): 532, 662, 678, 852, 1444

Myocard-Nekrose (homeopathic remedy from heart cells that died as a result of inadequate blood flow to them): 706, 789

Myoma (a benign tumor on the uterus): 253, 420, 453, 832

Myositis (involves progressive muscle weakness): 120, 122, 125, 129, 1124, 1169
Mycoplasma pneumonia (a contagious, bacterial pneumonia of children and young adults): 688

Nagel
1) Mykose (a disaccharide from which glucose can be hydrolized): 462, 654
2) Trichophytie (from a fungus): 133, 381, 812, 2422

Nasal polyp (benign growth inside the nasal passage): 542, 1436

Nasturtium (a healing herb): 143

Nematodes (roundworms): 771

Nephritis (kidney inflammation): 264

Neuralgia (a painful disorder of the nervous system): 833

Neurospora sitophila (homeopathic allergenic preparation): 705

Nigrospora spp (homeopathic allergenic preparation): 302

Nocardia asteroides (the microorganism causing Nocardiosis, an infectious pulmonary disease characterized by abscesses in the lungs): 237

Oligodena: 853

Ornithosis (or Psittacosis or Parrot Fever; an infectious pneumonia transmitted by certain birds): 331, 583, 1217

Osteitis (bone inflammation): 770

Osteomyelosclerosis (marrow replacement by bone in response to low-grade infection): 79, 330

Osteosinusitis max.: 243

Otitis Medinum (a homeopathic remedy for otitis media, middle ear swelling and/or infection): 316

Ovarian cyst: 982

Ovum: 752

Ox bile (the homeopathic remedy derived from it): 672

Papilloma virus (causes benign tumors having a branch or stalk): 907

Paracel: 232

Paradontose: 424, 1552

Parkinson's disease (a slowly progressive, degenerative, neurologic disorder): 813

Parrot Fever (or Ornithosis or Psittacosis; an infectious pneumonia transmitted by certain birds): 331, 583, 1217

Parvovirus, canine: 185, 323, 562, 613, 622, 1000, 4027 1) Mutant strain: 323, 514
2) Type B: 323, 535, 613, 755

Pasteurella combination (homeopathic nosode for bacterial diseases spread by animal bites): 913

Pemphigus (rare, autoimmune skin disorders characterized by blisters in the outer layer of skin and mucous membranes): 694, 893

Penicillium
1) Chyrosogenium: 344, 868, 1070, 2411
2) Notatum: 321, 555, 629, 825, 942
3) Rubrum: 332, 766, 1015
Pennyroyal (an herb): 772
Penqueculum: 746, 755, 1375, 6965
Pepto streptococcus: 201
Perniosis (a disorder of the blood vessels caused by prolonged exposure to cold and characterized by skin lesions on the lower legs, hands, toes, feet, ears and face): 232, 622, 822, 4211
Pertussis (whooping cough): 526, 765
Phoma Destructiva (homeopathic): 163
Plague (Yersenia pestis; spread primarily by rats): 333
Plasmacytoma (a tumor with plasma cells that occurs in the bone marrow, as in multiple myeloma, or outside of the bone marrow, as in tumors of the inner organs and lining of the nose, mouth, and throat): 475
Pneumococcus (the most common cause of bacterial pneumonia): 683
mixed flora: 158, 174, 645, 801
Pneumocystis (A fungally-induced pneumonia usually developing in the immuno-suppressed presence of AIDS): 204, 340, 742
Pneumonia
1) Klebsiella pneumoniae (the bacterium causing acute, bacterial pneumonia): 412, 766
2) Mycoplasma: 688
Polio (or poliomyelitis): 742, 1500, 2632
Polyp, uterine: 689
Porphyria (several rare disorders of the nervous system and skin): 698
Prostate Adenominum (homeopathic remedy for prostate tumor): 442, 1875
Protozoa: 432, 753
Pseudomonas (bacteria often found in wounds, burns, and infections of the urinary tract that are not controlled by antibiotics): 174, 482, 5311
Psittacosis (or Ornithosis or Parrot Fever; an infectious pneumonia transmitted by certain birds): 583, 1217
Psorinum (homeopathic nosode for psoriasis): 786
Pullularia pullulans (a homeopathic allergenic remedy): 1364
Pyelitis/proteus (bacteria commonly found in hospital-borne conditions): 594
Pyocyanus (homeopathic nosode for Pseudomonas pyocyanea): 437
Pyodermia (or Pyoderma Gangrenosum; a rare skin disorder of unknown cause. Small pustules develop into large ulcers at various sites on the body.): 123
Pyrogenium (homeopathic remedy for pus) (62): 429, 594, 622
mayo: 1625
Q Fever (an infectious disease caused by contact with animals with the parasitic Rickettsia bacteria, Coxiella burnetii whose symptoms may include headache, fever, chills, and sweats): 1357
Rabies (or hydrophobia): 547, 793
Reproductive: 622
Rhesus gravidatum: 684
Rheuma: 952
Rheumaticus: 333, 376
Rhinopneumonitis: 185, 367, 820
Rhizopus nigricans: 132
Rhodo Torula: 833
Rhodococcus: 124, 835
Rickettsia (bacteria that are transmitted to man by lice, fleas, ticks, and mites): 129, 632, 943, 1062
Rocky Mountain spotted fever: 375, 862, 943
Round worms: 240, 650, 688
Rubella (German or 3-day measles): 431, 510
Rubella vaccine: 459
Rubeola (9-day measles): 342, 467, 520, 1489
Rubeola vaccine: 962
Salivary gland virus (human herpes type 5): 126, 597, 1045, 2145
Salmonella: 1522
1) Type B: 546, 1634
2) Paratyphi B: 59, 92, 643, 707, 717, 972, 7771
3) Typhi: 420
Sanguis menst: 591
Sarcoma, Kaposi's: 249, 418
Schistosoma
1) Haematobium: 847, 867
2) Mansonii: 329
Schuman B-cell: 322, 425, 428, 561, 600, 620, 623, 780, 781, 950, 952, 1023, 1524
Sclerosis, lateral (degeneration of spinal cord resulting in spastic paraplegia): 254
Semperillium: 1140
Serum Schweinepest: 503
Shingles (Herpes zoster): 574, 1557
Sinusitis: 456
1) Frontalis: 952
2) Maxillars: 160
Smallpox (an extremely contagious viral disease marked by fever, prostration, and a rash of small blisters): 142, 476, 511, 876, 1644, 2132, 2544
Smegma: 180
Solitary cyst: 75, 543
Sorghum smut (homeopathic preparation for an allergen): 294
Sporobolomyces: 753
Sporotrichum pruinosum: 755
Staphylococcus: 453, 550, 1109
1) *Aureus*: 424, 727, 786, 943, 1050
2) *Coagulae positive*: 643

Stemphylium: 461

Streptococcus
1) *Haemolytic*: 134, 535, 542, 1415, 1522, 1902
2) *Viridans*: 425, 433, 445, 1010, 1060
3) *Virus*: 563, 611, 727

Streptomyces griseolus: 887

Strongyloides (genus of roundworms): 332, 422, 721, 942, 3212

Struma
1) *Cystica*: 5311
2) *Nodosa*: 105, 122, 321, 517, 532, 651
3) *Parenchyme*: 121

Sudor pedis: 148

Swine flu: 413, 432, 663, 839, 995

Syphilimum/Luesinum (a homeopathic remedy for syphilis): 177

T-cell leukemia: 222, 262, 822, 3042, 3734

Taenia: 187

Tape worms: 522, 562, 843, 1223, 3032, 5522

Tetanus: 352, 554, 1142

Tetanus anti-toxin: 363, 458

Tetragenus: 393, 2712

Thermi bacteria: 233, 441

Thread worms: 422, 423, 732, 4412

Tobacco mosaic (homeopathic preparation for an allergen): 233, 274, 543, 782, 1052

Tonsillar
1) *Nos*: 1656
2) *Pfropfe*: 246

Tonsillitis: 144, 452

Torulopsisosis (a common yeast causing disease for those in weakened condition or with suppressed immune function): 354, 522, 872, 2121

Toxoplasmosis (a serious, infectious disease that can be either acquired or present at birth and that is commonly contracted by handling contaminated cat litter): 434, 852

Trichinosis (the very serious parasitism resulting from eating pork or bear meat): 101, 541, 822, 1054, 1372

Trichoderma: 711

Trichomonas (a microorganism causing vaginal irritation with discharge and itching): 610, 692, 980
Trichophytie: 132, 812, 2422, 9493

Trichophyton
1) Mentagrophytes: 311
2) Rubrum: 752, 923

Tonsuraus: 765

Trypanosoma gambiense: 255, 316

Tuberculoma: 522, 1085, 1099, 1700

Tuberculosis
1) Aviare: 303, 332, 342, 532, 3113
2) Bovine: 523, 3353
3) Klebs': 221, 1132, 1644, 2313, 6516

Tularemia (a serious infectious disease also called deerfly fever or rabbit fever): 324, 427, 823

Tumor, brain: 543, 641, 857

Ulcer, ventric: 232, 1000

Urea-plasma: 756

Uremia (also known as uremic poisoning; excessive amounts of nitrogenous waste products in the blood, as seen in kidney failure): 911

Uterine polyp: 689

Vaccineinum (a homeopathic nosode): 476

Varicella (the herpes virus that causes chickenpox during childhood and shingles [herpes zoster] in adulthood): 345, 668, 716, 738

Varicola (also known as smallpox, an extremely contagious viral disease marked by fever, prostration, and a rash of small blisters): 142, 476, 511, 876, 1644, 2132, 2544

Variolinum (homeopathic smallpox nosode): 542, 569, 832, 3222

Verruca (a rough-surfaced, supposedly-harmless, virus-caused skin wart): 644, 767, 953

Werlhof: 690

Wolhynia fever (a Rickettsia illness, transmitted by lice, that is debilitating and conducive to relapse): 547

Yeast, "ultimate": 72, 254, 422, 582, 787, 1016, 1134, 1153, 2222

Yellow fever (a severe, viral infection causing damage to the liver, kidneys, heart, and entire gastrointestinal tract): 142, 178, 232, 432, 734, 1187

Yersenia pestis (also called Pasteurella pestis: causes plague; spread primarily by rats): 333

Zygomycosis (also called mucormycosis; a serious fungal infection usually associated with uncontrolled diabetes mellitus or immunosuppressive drugs): 942

See Frequency List 2 for more specific conditions and associated frequencies.
<table>
<thead>
<tr>
<th>Condition</th>
<th>Frequencies</th>
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<tbody>
<tr>
<td>General Program (Align Individual)</td>
<td>20, 60, 95, 125, 225, 427, 440, 660, 727, 787, 800, 880, 10000</td>
</tr>
<tr>
<td>Abdominal inflammation</td>
<td>380, 1.2, 2720, 2489, 2170, 1800, 1600, 1550, 880, 832, 787, 776, 727, 465, 444, 1865, 146, 125, 95, 72, 20, 450, 440, 428, 660</td>
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<tr>
<td>Abdominal pain</td>
<td>10000, 5000, 880, 3, 3000, 95, 2720, 2170, 1800, 1600, 1500, 880, 787, 776, 727, 465, 10000, 787, 727, 20, 880</td>
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<tr>
<td>Abscesses</td>
<td>2720, 2170, 1800, 787, 727, 190, 500</td>
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<tr>
<td>Acidosis (Also See Hyperacidity)</td>
<td>20, 146, 727, 776, 787, 880, 10000</td>
</tr>
<tr>
<td>Acne (Pimples)</td>
<td>2720, 2170, 1800, 1600, 1500, 880, 787, 776, 727, 465, 10000, 787, 727</td>
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<td>Acupuncture disturbance field (scar focus)</td>
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<td>Adnamia (geriatric (fatigue of age)</td>
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<td>Adrenal (near kidneys)</td>
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<td>Adrenal stimulant (ALWAYS USE 2489 and 465)</td>
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<td>Allergy</td>
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<td>Alopecia (hair loss)</td>
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<td>Anaphiasis</td>
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<td>Anemia</td>
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<td>Aneurysm (large blood vessels)</td>
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<td>Angina (quinsy in swat)</td>
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<td>Angina pectoris</td>
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<td>Anthrax</td>
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<td>Antiseptic effect</td>
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<td>Apoplexy stroke paralysis</td>
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<td>Arenas Tennus</td>
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<td>Arthritis</td>
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<td>Arthritis (arthralgia due to gout)</td>
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<td>Arthritis (disturbances - calcium metabolism)</td>
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<td>Arthritis (focal origin gastrogenic)</td>
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<td>Arthritis (muscles and tendons)</td>
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<td>Arthritis (rheumatism)</td>
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<td>Arthritis (rheumatoid (muscles and tendons)</td>
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<td>Astro Cytorma</td>
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<td>Astrocytoma</td>
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B&E Coli,rod,virus 727,787,800,803

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Back (Bent) 727,787,880,5000,10000

Backache 760,1550,880,787,727,10000

Bacteria 690

Bacteria Lactis Nosode 512,526,5412

Bacterial infections 465,866,690,727,787,832,880, 1550

Bacterium coil commune combo 282,333,413,957,1320,1722

Bad breath (halitosis) 1550,880,787,727,20,5000

Bad complexion 5000

Bad Teeth 20,727,787,880,5000,10000

Banal 1778

Barley Smut 377

Bed wetting (enuresis) 10000,5000,880,1550,787,727, 465

Bedsores (after done 20,then 1.2 and 73) 880,1550,787,727,465

Biliary Cirrhosis 381,514,677,2271

Biliary headache 8.5,3.5

Biliousness 1550,10000,880,832,787,727, 465,5000,10000

Bilirubin 717,726,731,863

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Bladder 880,800,787,727

Bladder and prostate complaints 880,1550,787,727,465,20,9.39

Bladder TBC 771

Blastocystis Hominus 848,365,844,595

Blood (over heart area) 20 to 2200

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Blood Diseases 727,787,880,5000

Blood plasma cleaner 800

Blood Pressure High 727,787,880,5000,10000

Blood Pressure Low 20,727,787,880

Blue Cohash 364

Boils (Carbuncles) 20,880,1550,787,727,465,660, 5000

Boils open 20

Boils pus 5000

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Bone regeneration 2720

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Bone trauma (outs, fractures) 380,1550,10000,880,787,727
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522,20
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Colic 1550,832,787,727,20
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<td>Corns in feet</td>
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<td>Coxsackie B2</td>
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<td>Cricks in the neck</td>
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Ears hard to hear 20,727,787,880
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<td>Flashes hot</td>
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<td>Flatulence (gas)</td>
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<td>Flu '83-</td>
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Obsessive fears 10000
Occipital Neuralgia 727,787,880,5000
Oligodena 853
Operations (after surgery) 880,787,727,20
Operations before 20,727,787,880
Oral inflammation 727,787,880
Oral lesions 2720,2489,2008,1800,1600,1550,880,787,727,465,444,522,146
Orchitis (inflammation of testes due to 2720,2489,2170,2127,2008,1800,1600,1550,1500,880,832,787,776,727,690,666,5000
Ornithosis 583
Osteoarthritis (joint trouble) 1500,727,787,880,1500
Osteitis 2.65
Osteomyelitis 2720,2489,2170,2127,2008,1800,1600,1550,1500,880,832,787,776,727,690,666,5000
Ostitis 770
Ostitis Medimum 316
Otitus 727,787,880
Otosolerosis 9.19
Ovarian Cyst 982
Ovarian disorders 650,625,600,465,444,26,2720,2489,2170,2127,2008,1800,1600,1550,1500,880,832,787,776,727,690,666,5000
Ovarian elimination, to stimulate 20
Ovaries 880,787,727
Ovum 752
Pain abdominal 10000,5000
Pain acute 10000
Pain back 10000
Pain bunion 5000,20
Pain elbow 5000,230
Pain hip 5000
Pain knee 10000,20
Pain of cancer 3000,95,2127,2008,727,690,666
Pain of infection 3000,95,880,1550,787,776,727,
4.9

Pain paralysis, to remove 727,787,880
Pains after operations 727,787,880
Pains in the knee (see Knee Pains) 20,727,787,880,10000
Pancreas 15
Pancreas disorder 727,787,880,10000
Pancreatic insufficiency Secondary 650,625,600,465,444,26,2720,
2489,2170,2127,2008,1800,
1600,1550,1500,880,832,787,
776,727,690,666,20
Paradontose 1552
Paralysis nonspastic 10000,880,787,776,727,650,
625,600,444,1865,125,95,72,
20,9,19,8,25
Paralysis spastic 10000,880,787,776,727,650,
625,600,444,1865,125,95,72,
20,7,69
Parasites 20,60,727,787,800,880,120,
125,95,72,440,444,1865
Parathyroid 727,787,880
Paresis 9.4
Paresthesia 5.5
Parlomspms disease 38000,16000
Pelvic disorders 20,60,660,727,787,880,660,
1500
Pelvic inflammatory disease (PID) 2720,2489,2170,2127,2008,
1800,1600,1550,787,776,727,
690,666,650,625,600,465,444,
522,95,72,450,428
Pemniciosls 232,622,822,4211
Pemphigus 893
Penicillin Rubrum 332,766
Penicillium Chyrosogenium 344,2411
Penicillium Not 321,555,942
Penny Royal 772
Penqueculum 746,755,6965
Peptic Ulcers 880,787,776,727
Pepto Streptococcus 201
Pericarditis (inflamed heart covering) 2720,2170,1600,880,1550,787,
727,625,125,95,72,20,5000
Periodontal disease 727,787
Peritonitis 880,787,727
Persist disorders-phagocyte builder 20,727,787,880,5000,120
Pertussis 880,832,787,776,727,46,526,
765
Phaqocyross stimulates 20,125,727,787,880
Pharyngitis (Consider also food allergies) 2720,2489,1800,1600,1550,880,
787,776,727,465,440 380,1600,
20,522,146
Phlebitis 1500,776
Phoma Destructiva 163
Pineal (to stimulate) 20
Placenta: to expel or afterbirth

Plantaris

Plasmocytoma

Pleurisy

Plosis (eyelid droop)

Pneumococcus Mixed flora

Pneumocystis

Pneumonia

Polio

Poliomyelitis (Secondary complications)

Polyps (growths)

Poor appetite

Poor circulation

Porphria

Pre-op and post-op (surgery):

Prophylaxis general

Prostate

Prostate complaints

Prostate gland

Prostate tumor (malignant)

Prostatitis (benign prostate tumor)

Protozoa

Pruritis anus itching

Pseudomonis

Psitticosis

Psoriasis

Psoriasis ankylosing spondylitis

Psoriasis secondary complications

Psoriasis (skin trouble, red patches)

Psoriasis skin trouble

Psorinum

Ptosis (eyelid droop)

Ptosis drooping eyelid

Pullularia Pullulans

Pulse - men

Pulse - women

Pyelitis-Proteus

Pyocyanus

Pyoderma

Pyorrhea trench mouth
1550,880,787,776,727,465,444,  
522,146,5000

Pyrogenuim 429
Pyrogenuls mayo 1625
Q-Fieber 1357
Rabies 20,727,787,880,120
Radiation burns 727,787,880,10000
Raynads disease 20,727
Raynads disease, gangrene 880,787,727,20
Recovery from ANY illness) 3000,95,190,47.5,2720,2489,  
1800,1600,1550,1500,880,832,  
787,776,727,666,650,600,465
Relaxatton renal excretory insufficiency 7.83,10
Reproductive 622
Retrovirus variants 2489,465,727,787,880,448,800,  
10000
Rhesus Oravldatum 684
Rheuma 952
Rheumaticus 376
Rhinitis (runny nose) 1550,1500,880,787,727,465,  
522,146,120,20
Rhinopneumonltis 185,367,820
Rhizopus Nigricans 132
Rhodo Torula 833
Rhodococcus 124,835
Rickets Vitamin D and sunlight 880,5000
Rickettsia 129,943
Rocky Mountain Spotted Fever 943
Rubella (German measles) 727,787,880,20,517,431
Rubella Vac 459
Rubeola 787
Salmonella 1522
Salmonella B 546,1634
Salmonella Paratyphi B 717,643,972,707,59,92,7771
Sanguis Menst 591
Sarcoma 2127,2008,880,787,727,690,666
Saroma virus 2000 to 2100 (20)

END
Music and the Fibonacci Series

Musical scales are based on Fibonacci numbers

The Fibonacci series appears in the foundation of aspects of art, beauty and life. Even music has a foundation in the series, as:

There are 13 notes in the span of any note through its octave.
A scale is comprised of 8 notes, of which the 5th and 3rd notes create the basic foundation of all chords, and are based on whole tone which is 2 steps from the root tone, that is the 1st note of the scale.

Note too how the piano keyboard scale of C to C above of 13 keys has 8 white keys and 5 black keys, split into groups of 3 and 2.

While some might "note" that there are only 12 "notes" in the scale, if you don't have a root and octave, a start and an end, you have no means of calculating the gradations in between, so this 13th note as the octave is essential to computing the frequencies of the other notes. The word "octave" comes from the Latin word for 8, referring to the eight whole tones of the complete musical scale, which in the key of C are C-D-E-F-G-A-B-C.

In a scale, the dominant note is the 5th note of the major scale, which is also the 8th note of all 13 notes that comprise the octave. This provides an added instance of Fibonacci numbers in key musical relationships. Interestingly, 8/13 is .61538, which approximates phi. What's more, the typical three chord song in the key of A is made up of A, its Fibonacci & phi partner E, and D, to which A bears the same relationship as E does to A. This is analogous to the "A is to B as B is to C" basis for the golden section, or in this case "D is to A as A is to E."

Musical frequencies are based on Fibonacci ratios

Notes in the scale of western music are based on natural harmonics that are created by ratios of frequencies. Ratios found in the first seven numbers of the Fibonacci series (0, 1, 1, 2, 3, 5, 8) are related to key frequencies of musical notes.

<table>
<thead>
<tr>
<th>Fibonacci Ratio</th>
<th>Calculated Frequency</th>
<th>Tempered Frequency</th>
<th>Note in Scale</th>
<th>Musical Relationship</th>
<th>When A=432 *</th>
<th>Octave below</th>
<th>Octave above</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/1</td>
<td>440</td>
<td>440.00</td>
<td>A</td>
<td>Root</td>
<td>432</td>
<td>216</td>
<td>864</td>
</tr>
<tr>
<td>2/1</td>
<td>880</td>
<td>880.00</td>
<td>A</td>
<td>Octave</td>
<td>864</td>
<td>432</td>
<td>1728</td>
</tr>
<tr>
<td>2/3</td>
<td>293.33</td>
<td>293.66</td>
<td>D</td>
<td>Fourth</td>
<td>288</td>
<td>144</td>
<td>576</td>
</tr>
<tr>
<td>2/5</td>
<td>176</td>
<td>174.62</td>
<td>F</td>
<td>Aug Fifth</td>
<td>172.8</td>
<td>86.4</td>
<td>345.6</td>
</tr>
<tr>
<td>-----</td>
<td>-----</td>
<td>--------</td>
<td>---</td>
<td>-----------</td>
<td>-------</td>
<td>------</td>
<td>-------</td>
</tr>
<tr>
<td>3/2</td>
<td>660</td>
<td>659.26</td>
<td>E</td>
<td>Fifth</td>
<td>648</td>
<td>324</td>
<td>1296</td>
</tr>
<tr>
<td>3/5</td>
<td>264</td>
<td>261.63</td>
<td>C</td>
<td>Minor Third</td>
<td>259.2</td>
<td>129.6</td>
<td>518.4</td>
</tr>
<tr>
<td>3/8</td>
<td>165</td>
<td>164.82</td>
<td>E</td>
<td>Fifth</td>
<td>162 (Phi)</td>
<td>81</td>
<td>324</td>
</tr>
<tr>
<td>5/2</td>
<td>1,100.00</td>
<td>1,108.72</td>
<td>C#</td>
<td>Third</td>
<td>1080</td>
<td>540</td>
<td>2160</td>
</tr>
<tr>
<td>5/3</td>
<td>733.33</td>
<td>740.00</td>
<td>F#</td>
<td>Sixth</td>
<td>720</td>
<td>360</td>
<td>1440</td>
</tr>
<tr>
<td>5/8</td>
<td>275</td>
<td>277.18</td>
<td>C#</td>
<td>Third</td>
<td>270</td>
<td>135</td>
<td>540</td>
</tr>
<tr>
<td>8/3</td>
<td>1,173.33</td>
<td>1,174.64</td>
<td>D</td>
<td>Fourth</td>
<td>1152</td>
<td>576</td>
<td>2304</td>
</tr>
<tr>
<td>8/5</td>
<td>704</td>
<td>698.46</td>
<td>F</td>
<td>Aug. Fifth</td>
<td>691.2</td>
<td>345.6</td>
<td>1382.4</td>
</tr>
</tbody>
</table>

The calculated frequency above starts with A440 and applies the Fibonacci relationships. In practice, pianos are tuned to a "tempered" frequency, a man-made adaptation devised to provide improved tonality when playing in various keys. Pluck a string on a guitar, however, and search for the harmonics by lightly touching the string without making it touch the frets and you will find pure Fibonacci relationships.

* A440 is an arbitrary standard. The American Federation of Musicians accepted the A440 as standard pitch in 1917. It was then accepted by the U.S. government its standard in 1920 and it was not until 1939 that this pitch was accepted internationally. Before recent times a variety of tunings were used. It has been suggested by James Furia and others that A432 be the standard. A432 was often used by classical composers and results in a tuning of the whole number frequencies that are connected to numbers used in the construction of a variety of ancient works and sacred sites, such as the Great Pyramid of Egypt. The controversy over tuning still rages, with proponents of A432 or C256 as being more natural tunings than the current standard.

**Musical compositions often reflect Fibonacci numbers and phi**

Fibonacci and phi relationships are often found in the timing of musical compositions. As an example, the climax of songs is often found at roughly the phi point (61.8%) of the song, as opposed to the middle or end of the song. In a 32 bar song, this would occur in the 20th bar.

**Musical instruments are often based on phi**

Fibonacci and phi are used in the design of violins and even in the design of high quality speaker
Insight on Fibonacci relationship to dominant 5th in major scale contributed by Sheila Yurick
Golden ratio

The golden section is a line segment sectioned into two according to the golden ratio. The total length \( a+b \) is to the longer segment \( a \) as \( a \) is to the shorter segment \( b \).

In mathematics and the arts, two quantities are in the golden ratio if the ratio between the sum of those quantities and the larger one is the same as the ratio between the larger one and the smaller. The golden ratio is approximately 1.6180339887.

At least since the Renaissance, many artists and architects have proportioned their works to approximate the golden ratio—especially in the form of the golden rectangle, in which the ratio of the longer side to the shorter is the golden ratio—believing this proportion to be aesthetically pleasing. Mathematicians have studied the golden ratio because of its unique and interesting properties.

The golden ratio can be expressed as a mathematical constant, usually denoted by the Greek letter \( \varphi \) (phi). The figure of a golden section illustrates the geometric relationship that defines this constant. Expressed algebraically:

\[
\frac{a + b}{a} = \frac{a}{b} = \varphi .
\]

This equation has as its unique positive solution the algebraic irrational number

\[
\varphi = \frac{1 + \sqrt{5}}{2} \approx 1.6180339887 ...
\]

Other names frequently used for or closely related to the golden ratio are golden section (Latin: sectio aurea), golden mean, golden number, and the Greek letter phi (\( \phi \)). Other terms encountered include extreme and mean ratio, medial section, divine proportion (Italian: proporzione divina), divine section (Latin: sectio divina), golden proportion, golden cut, and mean of Phidias.
Construction of a **golden rectangle**:
1. Construct a unit square.
2. Draw a line from the midpoint of one side to an opposite corner.
3. Use that line as the radius to draw an arc that defines the long dimension of the rectangle.

### Calculation

<table>
<thead>
<tr>
<th>List of numbers</th>
<th>Irrational numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \gamma ) - ( \zeta(3) ) - ( \sqrt{2} ) - ( \sqrt{3} ) - ( \sqrt{5} ) - ( \varphi ) - ( e ) - ( \pi ) - ( \delta )</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Binary</th>
<th>1.10011100011011011...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decimal</td>
<td>1.6180339887498948482...</td>
</tr>
<tr>
<td>Hexadecimal</td>
<td>1.9E3779B97F4A7C15F39...</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Continued fraction</th>
<th>( 1 + \frac{1}{1 + \frac{1}{1 + \frac{1}{1 + \cdots}}} )</th>
</tr>
</thead>
</table>

| Algebraic form     | \( \frac{1 + \sqrt{5}}{2} \) |

Two quantities (positive numbers) \( a \) and \( b \) are said to be in the **golden ratio** \( \varphi \) if

\[
\frac{a + b}{a} = \frac{a}{b} = \varphi.
\]

This equation unambiguously defines \( \varphi \).

The right equation shows that \( a = b\varphi \), which can be substituted in the left part, giving

\[
\frac{b\varphi + b}{b\varphi} = \frac{b\varphi}{b}.
\]

Cancelling \( b \) yields
\[
\frac{\varphi + 1}{\varphi} = \varphi.
\]

Multiplying both sides by \(\varphi\) and rearranging terms leads to:
\[
\varphi^2 - \varphi - 1 = 0.
\]

The only positive solution to this quadratic equation is
\[
\varphi = \frac{1 + \sqrt{5}}{2} \approx 1.6180339887\ldots
\]

[edit] History

![Golden Ratio Symbol](image)

Mathematician Mark Barr proposed using the first letter in the name of Greek sculptor Phidias, \(\phi\), to symbolize the golden ratio. Usually, the lowercase form (\(\phi\)) is used. Sometimes, the uppercase form (\(\Phi\)) is used for the reciprocal of the golden ratio, \(1/\varphi\).

The golden ratio has fascinated intellectuals of diverse interests for at least 2,400 years:

"Some of the greatest mathematical minds of all ages, from Pythagoras and Euclid in ancient Greece, through the medieval Italian mathematician Leonardo of Pisa and the Renaissance astronomer Johannes Kepler, to present-day scientific figures such as Oxford physicist Roger Penrose, have spent endless hours over this simple ratio and its properties. But the fascination with the Golden Ratio is not confined just to mathematicians. Biologists, artists, musicians, historians, architects, psychologists, and even mystics have pondered and debated the basis of its ubiquity and appeal. In fact, it is probably fair to say that the Golden Ratio has inspired thinkers of all disciplines like no other number in the history of mathematics."


Ancient Greek mathematicians first studied what we now call the golden ratio because of its frequent appearance in geometry. The ratio is important in the geometry of regular pentagrams and pentagons. The Greeks usually attributed discovery of the ratio to Pythagoras or his followers. The regular pentagram, which has a regular pentagon inscribed within it, was the Pythagoreans' symbol.

Euclid's *Elements* (Greek: Στοιχεῖα) provides the first known written definition of what is now called the golden ratio: "A straight line is said to have been cut in extreme and mean ratio when, as the whole line is to the greater segment, so is the greater to the less."[8] Euclid explains a construction for cutting (sectioning) a line "in extreme and mean ratio", i.e. the golden ratio.[9] Throughout the *Elements*, several propositions (theorems in modern terminology) and their proofs employ the golden ratio.[10] Some of these propositions show that the golden ratio is an irrational number.

The name "extreme and mean ratio" was the principal term used from the 3rd century BC[8] until about the 18th century.
The modern history of the golden ratio starts with Luca Pacioli's *Divina Proportione* of 1509, which captured the imagination of artists, architects, scientists, and mystics with the properties, mathematical and otherwise, of the golden ratio.

The first known decimal calculation of the golden ratio as a decimal of "about 0.6180340" was written in 1597 by Prof. Michael Maestlin of the University of Tübingen to his former student Johannes Kepler.[11]

Since the twentieth century, the golden ratio has been represented by the Greek letter \( \varphi \) (phi, after Phidias, a sculptor who is said to have employed it) or less commonly by \( \tau \) (tau, the first letter of the ancient Greek root \( \tau \)ομή– meaning cut).

### [edit] Timeline

Timeline according to Priya Hemenway[12].

- **Phidias** (490–430 BC) made the *Parthenon* statues that seem to embody the golden ratio.
- **Plato** (427–347 BC), in his *Timaeus*, describes five possible regular solids (the Platonic solids, the tetrahedron, cube, octahedron, dodecahedron and icosahedron), some of which are related to the golden ratio.
- **Euclid** (c. 325–c. 265 BC), in his *Elements*, gave the first recorded definition of the golden ratio, which he called, as translated into English, "extreme and mean ratio" (Greek: ακρος και μεσος λογος).[8]
- **Fibonacci** (1170–1250) mentioned the numerical series now named after him in his *Liber Abaci*; the Fibonacci sequence is closely related to the golden ratio.
- **Luca Pacioli** (1445–1517) defines the golden ratio as the "divine proportion" in his *Divina Proportione*.
- **Johannes Kepler** (1571–1630) describes the golden ratio as a "precious jewel": "Geometry has two great treasures: one is the Theorem of Pythagoras, and the other the division of a line into extreme and mean ratio; the first we may compare to a measure of gold, the second we may name a precious jewel."
- **Charles Bonnet** (1720–1793) points out that in the spiral phyllotaxis of plants going clockwise and counter-clockwise were frequently two successive Fibonacci series.
- **Martin Ohm** (1792–1872) is believed to be the first to use the term *goldene Schnitt* (golden section) to describe this ratio.
- **Edouard Lucas** (1842–1891) gives the numerical sequence now known as the Fibonacci sequence its present name.
- **Mark Barr** (20th century) uses the Greek letter phi (\( \varphi \)), the initial letter of Greek sculptor Phidias's name, as a symbol for the golden ratio.
- **Roger Penrose** (b.1931) discovered a symmetrical pattern that uses the golden ratio in the field of aperiodic tilings, which led to new discoveries about quasicrystals.

### [edit] Aesthetics

Beginning in the Renaissance, a body of literature on the aesthetics of the golden ratio has developed. As a result, architects, artists, book designers, and others have been encouraged to use the golden ratio in the dimensional relationships of their works.

The first and most influential of these was *De Divina Proportione* by Luca Pacioli, a three-volume work published in 1509. Pacioli, a Franciscan friar, was known mostly as a mathematician, but he was also trained and keenly interested in art. *De Divina Proportione* explored the mathematics of the golden ratio. Though it is often said that Pacioli advocated the golden ratio's application to yield pleasing, harmonious proportions, Livio points out that that interpretation has been traced to an error in 1799, and that Pacioli actually advocated the Vitruvian system of rational proportions.[11]
Pacioli also saw Catholic religious significance in the ratio, which led to his work's title. Containing illustrations of regular solids by Leonardo Da Vinci, Pacioli's longtime friend and collaborator, De Divina Proportione was a major influence on generations of artists and architects.

[edit] Architecture

The Parthenon's facade showing an interpretation of golden rectangles in its proportions.

Some studies of the Acropolis, including the Parthenon, conclude that many of its proportions approximate the golden ratio. The Parthenon's facade as well as elements of its facade and elsewhere can be circumscribed by golden rectangles.[13] To the extent that classical buildings or their elements are proportioned according to the golden ratio, this might indicate that their architects were aware of the golden ratio and consciously employed it in their designs. Alternatively, it is possible that the architects used their own sense of good proportion, and that this led to some proportions that closely approximate the golden ratio. On the other hand, such retrospective analyses can always be questioned on the ground that the investigator chooses the points from which measurements are made or where to superimpose golden rectangles, and that these choices affect the proportions observed.

Some scholars deny that the Greeks had any aesthetic association with golden ratio. For example, Midhat J. Gazalé says, "It was not until Euclid, however, that the golden ratio's mathematical properties were studied. In the Elements (308 B.C.) the Greek mathematician merely regarded that number as an interesting irrational number, in connection with the middle and extreme ratios. Its occurrence in regular pentagons and decagons was duly observed, as well as in the dodecahedron (a regular polyhedron whose twelve faces are regular pentagons). It is indeed exemplary that the great Euclid, contrary to generations of mystics who followed, would soberly treat that number for what it is, without attaching to it other than its factual properties."[14] And Keith Devlin says, "Certainly, the oft repeated assertion that the Parthenon in Athens is based on the golden ratio is not supported by actual measurements. In fact, the entire story about the Greeks and golden ratio seems to be without foundation. The one thing we know for sure is that Euclid, in his famous textbook Elements, written around 300 B.C., showed how to calculate its value."[15] Near-contemporary sources like Vitruvius exclusively discuss proportions that can be expressed in whole numbers, i.e. commensurate as opposed to irrational proportions.

A geometrical analysis of the Great Mosque of Kairouan reveals a consistent application of the golden ratio throughout the design, according to Boussora and Mazouz.[16] It is found in the overall proportion of the plan and in the dimensioning of the prayer space, the court, and the minaret. Boussora and Mazouz also examined earlier archaeological theories about the mosque, and demonstrate the geometric constructions based on the golden ratio by applying these constructions to the plan of the mosque to test their hypothesis.

The Swiss architect Le Corbusier, famous for his contributions to the modern international style, centered his design philosophy on systems of harmony and proportion. Le Corbusier's faith in the
The mathematical order of the universe was closely bound to the golden ratio and the Fibonacci series, which he described as "rhythms apparent to the eye and clear in their relations with one another. And these rhythms are at the very root of human activities. They resound in man by an organic inevitability, the same fine inevitability which causes the tracing out of the Golden Section by children, old men, savages and the learned."[17]

Le Corbusier explicitly used the golden ratio in his Modulor system for the scale of architectural proportion. He saw this system as a continuation of the long tradition of Vitruvius, Leonardo da Vinci's "Vitruvian Man", the work of Leon Battista Alberti, and others who used the proportions of the human body to improve the appearance and function of architecture. In addition to the golden ratio, Le Corbusier based the system on human measurements, Fibonacci numbers, and the double unit. He took Leonardo's suggestion of the golden ratio in human proportions to an extreme: he sectioned his model human body's height at the navel with the two sections in golden ratio, then subdivided those sections in golden ratio at the knees and throat; he used these golden ratio proportions in the Modulor system. Le Corbusier's 1927 Villa Stein in Garches exemplified the Modulor system's application. The villa's rectangular ground plan, elevation, and inner structure closely approximate golden rectangles.[18]

Another Swiss architect, Mario Botta, bases many of his designs on geometric figures. Several private houses he designed in Switzerland are composed of squares and circles, cubes and cylinders. In a house he designed in Origlio, the golden ratio is the proportion between the central section and the side sections of the house.[19]

[edit] Art

The canvas of Lawrence Alma-Tadema's *The Roses of Heliogabalus* (1888), 213 cm by 132 cm, is a near-perfect golden rectangle.

Leonardo Da Vinci's illustration from *De Divina Proportione* applies the golden ratio to the human face.
Leonardo da Vinci's illustrations in *De Divina Proportione* (*On the Divine Proportion*) and his views that some bodily proportions exhibit the golden ratio have led some scholars to speculate that he incorporated the golden ratio in his own paintings. Some suggest that his *Mona Lisa*, for example, employs the golden ratio in its geometric equivalents. Whether Leonardo proportioned his paintings according to the golden ratio has been the subject of intense debate. The secretive Leonardo seldom disclosed the bases of his art, and retrospective analysis of the proportions in his paintings can never be conclusive.

Salvador Dalí explicitly used the golden ratio in his masterpiece, *The Sacrament of the Last Supper*. The dimensions of the canvas are a golden rectangle. A huge dodecahedron, with edges in golden ratio to one another, is suspended above and behind Jesus and dominates the composition.[20][1]

Mondrian used the golden section extensively in his geometrical paintings.[21]

Interestingly, a statistical study on 565 works of art of different great painters, performed in 1999, found that these artists had not used the golden ratio in the size of their canvases. The study concluded that the average ratio of the two sides of the paintings studied is 1.34, with averages for individual artists ranging from 1.04 (Goya) to 1.46 (Bellini).[22]

### Sculpture

The *Golden Ratio* sculpture by Andrew Rogers in Jerusalem.

Australian sculptor Andrew Rogers's 50-ton stone and gold sculpture entitled *Golden Ratio*, installed outdoors in Jerusalem. The height of each stack of stones, beginning from either end and moving toward the center, is the beginning of the Fibonacci sequence: 1, 1, 2, 3, 5, 8.

### Book design

See *Canons of page construction*.


According to Jan Tschichold,[24] "There was a time when deviations from the truly beautiful page proportions 2:3, 1:√3, and the Golden Section were rare. Many books produced between 1550 and 1770 show these proportions exactly, to within half a millimetre."
Perceptual studies

Studies by psychologists, starting with Fechner, have been devised to test the idea that the golden ratio plays a role in human perception of beauty. While Fechner found a preference for rectangle ratios centered on the golden ratio, later attempts to carefully test such a hypothesis have been, at best, inconclusive.[1][25]

Music

See also: Fibonacci numbers in popular culture

James Tenney reconceived his piece For Ann (rising), which consists of up to twelve computer-generated upwardly glissandoing tones (see Shepard tone), as having each tone start so it is the golden ratio (in between an equal tempered minor and major sixth) below the previous tone, so that the combination tones produced by all consecutive tones are a lower or higher pitch already, or soon to be, produced.

Ernő Lendvai analyzes Béla Bartók’s works as being based on two opposing systems, that of the golden ratio and the acoustic scale.[26] In Bartók’s Music for Strings, Percussion and Celesta the xylophone progression occurs at the intervals 1:2:3:5:8:5:3:2:1.[27] French composer Erik Satie used the golden ratio in several of his pieces, including Sonneries de la Rose+Croix. His use of the ratio gave his music an otherworldly symmetry.

The golden ratio is also apparent in the organisation of the sections in the music of Debussy’s Image, Reflections in Water, in which "the sequence of keys is marked out by the intervals 34, 21, 13 and 8, and the main climax sits at the phi position."[27]

This Binary Universe, an experimental album by Brian Transeau (aka BT), includes a track entitled "1.618" in homage to the golden ratio. The track features musical versions of the ratio and the accompanying video displays various animated versions of the golden mean.

Nature

Adolf Zeising, whose main interests were mathematics and philosophy, found the golden ratio expressed in the arrangement of branches along the stems of plants and of veins in leaves. He extended his research to the skeletons of animals and the branchings of their veins and nerves, to the proportions of chemical compounds and the geometry of crystals, even to the use of proportion in artistic endeavors. In these phenomena he saw the golden ratio operating as a universal law.[28] Zeising wrote in 1854:

[The Golden Ratio is a universal law] in which is contained the ground-principle of all formative striving for beauty and completeness in the realms of both nature and art, and which permeates, as a paramount spiritual ideal, all structures, forms and proportions, whether cosmic or individual, organic or inorganic, acoustic or optical; which finds its fullest realization, however, in the human form.[29]

See also History of aesthetics (pre-20th-century)

Mathematics

Golden ratio conjugate

The negative root of the quadratic equation for φ (the "conjugate root") is $1 - \varphi \approx -0.618$. The absolute value of this quantity ($\approx 0.618$) corresponds to the length ratio taken in reverse order.
(shorter segment length over longer segment length, b/a), and is sometimes referred to as the **golden ratio conjugate**\,[30]\) It is denoted here by the capital Phi (Φ):
\[
\Phi = \frac{1}{\varphi} \approx 0.61803\,39887.
\]
Alternatively, \(\Phi\) can be expressed as
\[
\Phi = \varphi - 1.
\]
This illustrates the unique property of the golden ratio among positive numbers, that
\[
\frac{1}{\varphi} = \varphi - 1
\]
or its inverse:
\[
\frac{1}{\Phi} = \Phi + 1.
\]

**[edit] Short proofs of irrationality**

Recall that we denoted the "larger part" by \(a\) and the "smaller part" by \(b\). If the golden ratio is a positive **rational number**, then it must be expressible as a fraction in **lowest terms** in the form \(a/b\) where \(a\) and \(b\) are **coprime** positive integers. The algebraic definition of the golden ratio then indicates that if \(a/b = \varphi\), then
\[
\frac{a}{b} = \frac{a + b}{a}.
\]
Multiplying both sides by \(ab\) leads to:
\[
a^2 = ab + b^2.
\]
Subtracting \(ab\) from both sides and factoring out \(a\) gives:
\[
a(a - b) = b^2.
\]
Finally, dividing both sides by \(b(a - b)\) yields:
\[
\frac{a}{b} = \frac{b}{a - b}.
\]
This last equation indicates that \(a/b\) could be further reduced to \(b/(a - b)\), where \(a - b\) is still positive, which is an equivalent fraction with smaller numerator and denominator. But since \(a/b\) was already given in lowest terms, this is a contradiction. Thus this number cannot be so written, and is therefore irrational.

Another short proof — perhaps more commonly known — of the irrationality of the golden ratio \(1 + \sqrt{5}/2\) makes use of the **closure** of rational numbers under addition and multiplication. If \(1 + \sqrt{5}/2\) is
rational, then \( \frac{1 + \sqrt{5}}{2} - \frac{1}{2} \) is also rational, which is a contradiction if it is already known that the square root of a non-square natural number is irrational.

**[edit] Alternate forms**

The formula \( \phi = 1 + 1/\phi \) can be expanded recursively to obtain a continued fraction for the golden ratio:[31]

\[
\phi = [1; 1, 1, 1, \ldots] = 1 + \cfrac{1}{1 + \cfrac{1}{1 + \cfrac{1}{1 + \cfrac{1}{1 + \cdots}}}}
\]

and its reciprocal:

\[
\phi^{-1} = [0; 1, 1, 1, \ldots] = 0 + \cfrac{1}{1 + \cfrac{1}{1 + \cfrac{1}{1 + \cdots}}}
\]

The convergents of these continued fractions (1, 2, 3/2, 5/3, 8/5, 13/8, ..., or 1, 1/2, 2/3, 3/5, 5/8, 8/13, ...) are ratios of successive Fibonacci numbers.

The equation \( \phi^2 = 1 + \phi \) likewise produces the continued square root form:

\[
\phi = \sqrt{1 + \sqrt{1 + \sqrt{1 + \sqrt{1 + \cdots}}}}
\]

Also:

\[
\phi = 1 + 2 \sin(\pi/10) = 1 + 2 \sin 18^\circ
\]
\[
\phi = \frac{1}{2} \csc(\pi/10) = \frac{1}{2} \csc 18^\circ
\]
\[
\phi = 2 \cos(\pi/5) = 2 \cos 36^\circ
\]

These correspond to the fact that the length of the diagonal of a regular pentagon is \( \phi \) times the length of its side, and similar relations in a pentagram.

\[
x^2 + 2x
\]

If \( x \) agrees with \( \phi \) to \( n \) decimal places, then \( x^2 + 1 \) agrees with it to \( 2n \) decimal places.

An equation derived in 1994 connects the golden ratio to the Number of the Beast (666):[1]

\[
-\frac{\phi}{2} = \sin 666^\circ = \cos(6 \cdot 6 \cdot 6^\circ).
\]

Which can be combined into the expression:
The golden ratio in a regular pentagon can be computed using Ptolemy's theorem.

\[ -\varphi = \sin 666^\circ + \cos(6 \cdot 6^\circ). \]

The golden ratio can also be found by applying Ptolemy's theorem to the quadrilateral formed by removing one vertex from a regular pentagon. If the quadrilateral's long edge and diagonals are \( b \), and short edges are \( a \), then Ptolemy's theorem says \( b^2 = a^2 + ab \) which yields

\[
\frac{b}{a} = \frac{1 + \sqrt{5}}{2}.
\]

A pentagram colored to distinguish its line segments of different lengths. The four lengths are in golden ratio to one another.

The number \( \varphi \) turns up frequently in geometry, particularly in figures with pentagonal symmetry. The length of a regular pentagon's diagonal is \( \varphi \) times its side. The vertices of a regular icosahedron are those of three mutually orthogonal golden rectangles.

There is no known general algorithm to arrange a given number of nodes evenly on a sphere, for any of several definitions of even distribution (see, for example, Thomson problem). However, a useful approximation results from dividing the sphere into parallel bands of equal area and placing one node in each band at longitudes spaced by a golden section of the circle, i.e. \( 360^\circ/\varphi \approx 222.5^\circ \).

This approach was used to arrange mirrors on the Starshine 3 satellite[32].

For more details on this topic, see Pentagram.
The golden ratio plays an important role in regular pentagons and pentagrams. Each intersection of edges sections other edges in the golden ratio. Also, the ratio of the length of the shorter segment to the segment bounded by the 2 intersecting edges (a side of the pentagon in the pentagram's center) is $\phi$, as the four-color illustration shows.

The pentagram includes ten isosceles triangles: five acute and five obtuse isosceles triangles. In all of them, the ratio of the longer side to the shorter side is $\phi$. The acute triangles are golden triangles. The obtuse isosceles triangles are a golden gnomon.

[edit] Scalenity of triangles

Consider a triangle with sides of lengths $a$, $b$, and $c$ in decreasing order. Define the "scalenity" of the triangle to be the smaller of the two ratios $a/b$ and $b/c$. The scalenity is always less than $\phi$ and can be made as close as desired to $\phi$. (*American Mathematical Monthly*, pp. 49-50, 1954.)

[edit] Relationship to Fibonacci sequence

Approximate and true golden spirals. The green spiral is made from quarter-circles tangent to the interior of each square, while the red spiral is a Golden Spiral, a special type of logarithmic spiral. Overlapping portions appear yellow. The length of the side of a larger square to the next smaller square is in the golden ratio.

A Fibonacci spiral that approximates the Golden Spiral.

The mathematics of the golden ratio and of the Fibonacci sequence are intimately interconnected.

Recall that the Fibonacci number sequence is:

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

The explicit expression for the Fibonacci sequence involves the golden ratio:

$$F(n) = \frac{\varphi^n - (1 - \varphi)^n}{\sqrt{5}} = \frac{\varphi^n - (-\varphi)^{-n}}{\sqrt{5}}.$$

The golden ratio is the limit of the ratios of successive terms of the Fibonacci sequence (or any Fibonacci-like sequence):
Therefore, if a Fibonacci number is divided by its immediate predecessor in the sequence, the quotient approximates \( \varphi \); e.g., \( 987/610 \approx 1.6180327868852 \). These approximations are alternately lower and higher than \( \varphi \), and converge on \( \varphi \) as the Fibonacci numbers increase, and:

\[
\lim_{n \to \infty} \frac{F(n+1)}{F(n)} = \varphi.
\]

Furthermore, the successive powers of \( \varphi \) obey the Fibonacci recurrence:

\[
\varphi^{n+1} = \varphi^n + \varphi^{n-1}.
\]

This identity allows any polynomial in \( \varphi \) to be reduced to a linear expression. For example:

\[
3\varphi^3 - 5\varphi^2 + 4 = 3(\varphi^2 + \varphi) - 5\varphi^2 + 4 = 3[(\varphi+1) + \varphi] - 5(\varphi+1) + 4 = \varphi + 2 \approx 3.618.
\]

[edit] Other properties

The golden ratio has the simplest expression (and slowest convergence) as a continued fraction expansion of any irrational number (see Alternate forms above). It is, for that reason, one of the worst cases of the Lagrange's approximation theorem. This may be the reason angles close to the golden ratio often show up in phyllotaxis (the growth of plants).

The defining quadratic polynomial and the conjugate relationship lead to decimal values that have their fractional part in common with \( \varphi \):

\[
\varphi^2 = \varphi + 1 = 2.618... \\
\frac{1}{\varphi} = \varphi - 1 = 0.618... 
\]

The sequence of powers of \( \varphi \) contains these values 0.618..., 1.0, 1.618..., 2.618...; more generally, any power of \( \varphi \) is equal to the sum of the two immediately preceding powers:

\[
\varphi^n = \varphi^{n-1} + \varphi^{n-2} = \varphi \cdot F_n + F_{n-1}.
\]

As a result, one can easily decompose any power of \( \varphi \) into a multiple of \( \varphi \) and a constant. The multiple and the constant are always adjacent Fibonacci numbers. This leads to another property of the positive powers of \( \varphi \):

If \( \lfloor n/2 - 1 \rfloor = m \), then:

\[
\varphi^n = \varphi^{n-1} + \varphi^{n-3} + \ldots + \varphi^{n-1-2m} + \varphi^{n-2-2m}.
\]

When the golden ratio is used as the base of a numeral system (see Golden ratio base, sometimes dubbed phinary or \( \varphi \)-nary), every integer has a terminating representation, despite \( \varphi \) being irrational, but every fraction has a non-terminating representation.

The golden ratio is the fundamental unit of the algebraic number field \( \mathbb{Q}(\sqrt{5}) \) and is a Pisot-Vijayaraghavan number.
Decimal expansion

Calculation methods

The golden ratio’s decimal expansion can be calculated directly from the expression

$$\varphi = \frac{1 + \sqrt{5}}{2}.$$  

with $\sqrt{5} \approx 2.2360677974997896964$. The square root of 5 can be calculated with the Babylonian method, starting with an initial estimate such as $x_1 = 2$ and iterating

$$x_{n+1} = \frac{(x_n + 5/x_n)}{2}$$

for $n = 1, 2, 3, \ldots$, until the difference between $x_n$ and $x_{n-1}$ becomes zero, to the desired number of digits.

The Babylonian algorithm for $\sqrt{5}$ is equivalent to Newton's method for solving the equation $x^2 – 5 = 0$. In its more general form, Newton's method can be applied directly to any algebraic equation, including the equation $x^2 - x - 1 = 0$ that defines the golden ratio. This gives an iteration that converges to the golden ratio itself,

$$x_{n+1} = \frac{x_n^2 + 1}{2x_n - 1},$$

for an appropriate initial estimate $x_1$ such as $x_1 = 1$. A slightly faster method is to rewrite the equation as $x - 1 - 1/x = 0$, in which case the Newton iteration becomes

$$x_{n+1} = \frac{x_n^2 + 2x_n}{x_n^2 + 1}.$$

These iterations all converge quadratically: that is, each step roughly doubles the number of correct digits. The golden ratio is therefore relatively easy to compute with arbitrary precision. The time needed to compute $n$ digits of the golden ratio is proportional to the time needed to divide two $n$-digit numbers. This is considerably faster than known algorithms for the transcendental numbers $\pi$ and $e$.

An easily programmed alternative using only integer arithmetic is to calculate two large consecutive Fibonacci numbers and divide them. The ratio of Fibonacci numbers $F_{25001}$ and $F_{25000}$, each over 5000 digits, yields over 10,000 significant digits of the golden ratio.

Decimal expansion to 1,050 places

(sequence A001622 in OEIS)

1.6180339887 4989484820 4586834365 6381177203 0917980576 2862135448 6227052604 6281890244 9707207204 1893911374 8475408807 5386891752 1266338622 2353693179 3180060766 8925017116 9620703222 1043216269 5486262963 1361443814 9758701220 3408058879 5445474924 6185695364 8644492410 4432077134 4947049565 8467885098 7433944221 2544877066 4780915884 6074998871 2400765217 0575179788
A regular square pyramid is determined by its medial right triangle, whose edges are the pyramid's apothem (a), semi-base (b), and height (h); the face inclination angle is also marked. Mathematical proportions \(b:h:a\) of \(1 : \sqrt{\phi} : \phi\) and \(3 : 4 : 5\) and \(1 : 4/\pi : 1.6189\) are of particular interest in relation to Egyptian pyramids.

Both Egyptian pyramids and those mathematical regular square pyramids that resemble them can be analyzed with respect to the golden ratio and other ratios.

### Mathematical pyramids and triangles

A pyramid in which the apothem (slant height along the bisector of a face) is equal to \(\phi\) times the semi-base (half the base width) is sometimes called a golden pyramid. The isosceles triangle that is the face of such a pyramid can be constructed from the two halves of a diagonally split golden rectangle (of size semi-base by apothem), joining the medium-length edges to make the apothem.

The height of this pyramid is \(\sqrt{\phi}\) times the semi-base (that is, the slope of the face is \(\sqrt{\phi}\)); the square of the height is equal to the area of a face, \(\phi\) times the square of the semi-base.

The medial right triangle of this "golden" pyramid (see diagram), with sides \(1 : \sqrt{\phi} : \phi\) is interesting in its own right, demonstrating via the Pythagorean theorem the relationship

\[
\sqrt{\phi} = \sqrt{\phi^2 - 1} \quad \text{or} \quad \phi = \sqrt{1 + \phi}.
\]

This "Kepler triangle"[33] is the only right triangle proportion with edge lengths in geometric progression,[34] just as the 3–4–5 triangle is the only right triangle proportion with edge lengths in arithmetic progression. The angle with tangent \(\sqrt{\phi}\) corresponds to the angle that the side of the pyramid makes with respect to the ground, 51.827... degrees (51° 49′ 38″).[35]

A nearly similar pyramid shape, but with rational proportions, is described in the Rhind
Mathematical Papyrus (the source of a large part of modern knowledge of ancient Egyptian mathematics), based on the 3:4:5 triangle,[36] the face slope corresponding to the angle with tangent 4/3 is 53.13 degrees (53 degrees and 8 minutes).[37] The slant height or apothem is 5/3 or 1.666... times the semi-base. The Rhind papyrus has another pyramid problem as well, again with rational slope (expressed as run over rise). Egyptian mathematics did not include the notion of irrational numbers,[38] and the rational inverse slope (run/rise, multiplied by a factor of 7 to convert to their conventional units of palms per cubit) was used in the building of pyramids.[36]

Another mathematical pyramid with proportions almost identical to the "golden" one is the one with perimeter equal to $2\pi$ times the height, or $h:b = 4:\pi$. This triangle has a face angle of $51.854^\circ$ ($51^\circ51'$), very close to the 51.827° of the golden triangle. This pyramid relationship corresponds to the coincidental relationship $\sqrt{\phi} \approx 4/\pi$.

Egyptian pyramids very close in proportion to these mathematical pyramids are known.[37]

[edit] Egyptian pyramids

The shapes of Egyptian pyramids include one that is remarkably close to a "golden pyramid". This is the Great Pyramid of Giza (also known as the Pyramid of Cheops or Khufu). Its slope of 51° 52' is extremely close to the "golden" pyramid inclination of 51° 50' and the $\pi$-based pyramid inclination of 51° 51'; other pyramids at Giza (Chephren, 52° 20', and Mycerinus, 50° 47')[36] are also quite close. Whether the relationship to the golden ratio in these pyramids is by design or by accident remains a topic of controversy. Several other Egyptian pyramids are very close to the rational 3:4:5 shape.[37]

Michael Rice[39] asserts that principal authorities on the history of Egyptian architecture have argued that the Egyptians were well acquainted with the Golden ratio and that it is part of mathematics of the Pyramids, citing Giedon (1957).[40] He also asserts that some recent historians of science have denied that the Egyptians had any such knowledge, contending rather that its appearance in an Egyptian building is the result of chance.

In 1859, the Pyramidologist John Taylor (1781-1864) asserted that in the Great Pyramid of Giza built around 2600 BC, the golden ratio is represented by the ratio of the length of the face (the slope height), inclined at an angle $\theta$ to the ground, to half the length of the side of the square base, equivalent to the secant of the angle $0.[41]$ The above two lengths were about 186.4 and 115.2 meters respectively. The ratio of these lengths is the golden ratio, accurate to more digits than either of the original measurements.

Howard Vyse, according to Matila Ghyka,[42] reported the great pyramid height 148.2 m, and half-base 116.4 m, yielding 1.6189 for the ratio of slant height to half-base, again more accurate than the data variability.

Adding fuel to controversy over the architectural authorship of the Great Pyramid, Eric Temple Bell, mathematician and historian, asserts that Egyptian mathematics as understood in modern times, would not have supported the ability to calculate the slant height of the pyramids, or the ratio to the height, except in the case of the 3:4:5 pyramid, since the 3:4:5 triangle was the only right triangle known to the Egyptians, and they did not know the Pythagorean theorem nor any way to reason about irrationals such as $\pi$ or $\phi$.[43]

[edit] Disputed sightings of the golden ratio

Empirical sightings of the golden ratio in numerous natural proportions and artistic proportions are necessarily just approximations, to a wide range of accuracies. For example, historian John Man suggests that Gutenberg's Bible page was "based on the golden section shape," even though its page size is $44.5 \text{ cm} \times 30.7 \text{ cm}$, which is a ratio of 1.45.[44]
Examples of disputed observations of the golden ratio include:

- A connection has been proposed between the Fibonacci numbers (Golden Ratio) and Chargaff's second rule concerning the proportions of nucleobases in the human genome.[45]

- It is sometimes claimed that the number of bees in a beehive divided by the number of drones yields the golden ratio.[46] In reality, the proportion of drones in a beehive varies greatly by beehive, by bee race, by season, and by beehive health status; the ratio is normally much greater than the golden ratio (usually close to 20:1 in healthy colonies). [citation needed] This misunderstanding may arise because in theory bees have approximately this ratio of male to female ancestors (See The Bee Ancestry Code) - the caveat being that ancestry can trace back to the same drone by more than one route, so the actual numbers of bees do not need to match the formula.

- Some specific proportions in the bodies of many animals (including humans[47][48]) and parts of the shells of mollusks[3] and cephalopods are often claimed to be in the golden ratio. There is actually a large variation in the real measures of these elements in a specific individual and the proportion in question is often significantly different from the golden ratio.[47] The ratio of successive phalangeal bones of the digits and the metacarpal bone has been said to approximate the golden ratio.[48] The Nautilus shell, whose construction proceeds in a logarithmic spiral, is often cited, usually under the idea that any logarithmic spiral is related to the golden ratio, but sometimes with the claim that each new chamber is proportioned by the golden ratio relative to the previous one.[46]

- The proportions of different plant components (numbers of leaves to branches, diameters of geometrical figures inside flowers) are often claimed to show the golden ratio proportion in several species.[49] In practice, there are significant variations between individuals, seasonal variations, and age variations in these species. While the golden ratio may be found in some proportions in some individuals at particular times in their life cycles, there is no consistent ratio in their proportions.[citation needed]

- In investing, some practitioners of technical analysis use the golden ratio to indicate support of a price level, or resistance to price increases, of a stock or commodity; after significant price changes up or down, new support and resistance levels are supposedly found at or near prices related to the starting price via the golden ratio.[50] The use of the golden ratio in investing is also related to more complicated patterns described by Fibonacci numbers; see, e.g. Elliott wave principle. However, other market analysts have published analyses suggesting that these percentages and patterns are not supported by the data.[51]

- ISO 7810 cards such as Visa or MasterCard have an aspect ratio of 1.586, which is only 2% smaller than the golden ratio.

- A rectangle that is one mile long by one kilometer wide is within 1% of a golden rectangle, with a mile being exactly 1.609344 km.

[edit] See also

- Aesthetics
- Golden angle
- Golden function
- Golden rectangle
- Golden triangle (mathematics)
- Golden section search
- Phi (letter)
- Kepler triangle
- Logarithmic spiral
- Fibonacci number
- Modulor
Sacred geometry
The Roses of Heliogabalus
Plastic number
Penrose tiles
Dynamic symmetry
Golden ratio base
Vitruvian man
Square root of 5

References and footnotes

4. ^ Summerson John, Heavenly Mansions: And Other Essays on Architecture (New York: W.W. Norton, 1963) pp.37. "And the same applies in architecture, to the rectangles representing these and other ratios (e.g. the 'golden cut'). The sole value of these ratios is that they are intellectually fruitful and suggest the rhythms of modular design."
8. ^ Euclid, Elements, Book 6, Definition 3.
10. ^ Euclid, Elements, Book 2, Proposition 11; Book 4, Propositions 10–11; Book 13, Propositions 1–6, 8–11, 16–18.
22. Olariu, Agata, *Golden Section and the Art of Painting*. Available online
23. Ibid. Tschichold, pp.43 Fig 4. "Framework of ideal proportions in a medieval manuscript without multiple columns. Determined by Jan Tschichold 1953. Page proportion 2:3. margin proportions 1:1:2:3. Text area proportioned in the Golden Section. The lower outer corner of the text area is fixed by a diagonal as well."
25. The golden ratio and aesthetics, by Mario Livio
41. Taylor, *The Great Pyramid: Why Was It Built and Who Built It?*, 1859
44. Man, John, *Gutenberg: How One Man Remade the World with Word* (2002) pp. 166-67, Wiley, ISBN 0-471-21823-5. "The half-folio page (30.7 x 44.5 cm) was made up of two rectangles—the whole page and its text area—based on the so called 'golden section', which specifies a crucial relationship between short and long sides, and produces an irrational number, as pi is, but is a ratio of about 5:8 (footnote: The ratio is 0.618.... ad inf' commonly rounded to 0.625)"


[edit] Further reading


[edit] External links

Wikimedia Commons has media related to:

Golden ratio

- Eric W. Weisstein, Golden Ratio at MathWorld.
- PHI: The Divine Ratio
- The On-Line Encyclopedia of Integer Sequences
- The Pentagram & The Golden Ratio - with many problems to consider
- Misconceptions about the golden ratioPDF (2.04 MiB)
- Fascinating Flat Facts about Phi (Some excellent phi pages by Dr. R Knott)
- Golden Ratio in Geometry

The Golden Section

The Golden Section is a ratio based on a phi

The Golden Section is also known as the Golden Mean, Golden Ratio and Divine Proportion. It is a ratio or proportion defined by the number Phi ($\phi = 1.61803988749895...$)

It can be derived with a number of geometric constructions, each of which divides a line segment at the unique point where:

\[
\begin{align*}
\text{the ratio of the whole line (A) to the large segment (B)}
\quad & \text{is the same as} \\
\text{the ratio of the large segment (B) to the small segment (C)}. \\
\end{align*}
\]

In other words, A is to B as B is to C.

This occurs only where A is $1.618 ...$ times B and B is $1.618 ...$ times C.

This ratio has been used by mankind for centuries

Its use may have started as early as with the Egyptians in the design of the pyramids,

The Greeks recognized it as "dividing a line in the extreme and mean ratio"

and used it for beauty

The Renaissance artists knew it as the Divine Proportion

and used it for beauty
and balance in the design of architecture and balance in the design of art

It was used in the design of Notre Dame in Paris and continues today in many examples of art, architecture and design.

It also appears in the physical proportions of the human body, movements in the stock market and many other aspects of life and the universe.
Music and the Fibonacci Series

Musical scales are based on Fibonacci numbers

The Fibonacci series appears in the foundation of aspects of art, beauty and life. Even music has a foundation in the series, as:

13 notes separate each octave of
8 notes in a scale, of which the
5th and 3rd notes create the basic foundation of all chords, and
are based on whole tone which is
2 steps from the root tone, that is the
1st note of the scale.

Note too how the piano keyboard scale of 13 keys has 8 white keys and 5 black keys, split into groups of 3 and 2.

Musical frequencies are based on Fibonacci ratios

Notes in the scale of western music have a foundation in the Fibonacci series, as the frequencies of musical notes have relationships based on Fibonacci numbers:

<table>
<thead>
<tr>
<th>Fibonacci Ratio</th>
<th>Calculated Frequency</th>
<th>Tempered Frequency</th>
<th>Note in Scale</th>
<th>Musical Relationship</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/1</td>
<td>440</td>
<td>440.00</td>
<td>A</td>
<td>Root</td>
</tr>
<tr>
<td>2/1</td>
<td>880</td>
<td>880.00</td>
<td>A</td>
<td>Octave</td>
</tr>
<tr>
<td>2/3</td>
<td>293.33</td>
<td>293.66</td>
<td>D</td>
<td>Fourth</td>
</tr>
<tr>
<td>2/5</td>
<td>176</td>
<td>174.62</td>
<td>F</td>
<td>Aug Fifth</td>
</tr>
<tr>
<td>3/2</td>
<td>660</td>
<td>659.26</td>
<td>E</td>
<td>Fifth</td>
</tr>
<tr>
<td>3/5</td>
<td>264</td>
<td>261.63</td>
<td>C</td>
<td>Minor Third</td>
</tr>
<tr>
<td>3/8</td>
<td>165</td>
<td>164.82</td>
<td>E</td>
<td>Fifth</td>
</tr>
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<td>5/2</td>
<td>1,100.00</td>
<td>1,108.72</td>
<td>C#</td>
<td>Third</td>
</tr>
<tr>
<td>5/3</td>
<td>733.33</td>
<td>740.00</td>
<td>F#</td>
<td>Sixth</td>
</tr>
<tr>
<td>5/8</td>
<td>275</td>
<td>277.18</td>
<td>C#</td>
<td>Third</td>
</tr>
<tr>
<td>8/3</td>
<td>1,173.33</td>
<td>1,174.64</td>
<td>D</td>
<td>Fourth</td>
</tr>
<tr>
<td>8/5</td>
<td>704</td>
<td>698.46</td>
<td>F</td>
<td>Aug. Fifth</td>
</tr>
</tbody>
</table>
The calculated frequency above starts with A440 and applies the Fibonacci relationships. In practice, pianos are tuned to a "tempered" frequency to provide improved tonality when playing in various keys.

**Musical compositions often reflect Fibonacci numbers and phi**

Fibonacci and phi relationships are often found in the timing of musical compositions. As an example, the climax of songs is often found at roughly the phi point (61.8%) of the song, as opposed to the middle or end of the song. In a 32 bar song, this would occur in the 20th bar.

**Musical instruments are often based on phi**

Fibonacci and phi are used in the design of violins and even in the design of high quality speaker wire.
Shepard tone

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Figure 1: Shepard tones forming a Shepard scale, illustrated in a sequencer

A Shepard tone, named after Roger Shepard, is a sound consisting of a superposition of sine waves separated by octaves. When played with the base pitch of the tone moving upwards or downwards, it is referred to as the Shepard scale. This creates the auditory illusion of a tone that continually ascends or descends in pitch, yet which ultimately seems to get no higher or lower.[1]

[edit] Construction of a Shepard scale

The illusion can be constructed by creating a series of overlapping ascending or descending scales. Similar to the Penrose stairs optical illusion (as in M.C. Escher's lithograph Ascending and Descending) or a barber's pole, the basic concept is shown in Figure 1.

Each square in the figure indicates a tone, any set of squares in vertical alignment together making one Shepard tone. The color of each square indicates the loudness of the note, with purple being the quietest and green the loudest. Overlapping notes that play at the same time are exactly one octave apart, and each scale fades in and fades out so that hearing the beginning or end of any given scale is impossible. As a conceptual example of an ascending Shepard scale, the first tone could be an almost inaudible C(4) (middle C) and a loud C(5) (an octave higher). The next would be a slightly louder C#(4) and a slightly quieter C#(5); the next would be a still louder D(4) and a still quieter D(5). The two frequencies would be equally loud at the middle of the octave (F#), and the twelfth tone would be a loud B(4) and an almost inaudible B(5) with the addition of an almost inaudible B(3). The thirteenth tone would then be the same as the first, and the cycle could continue indefinitely. (In other words, each tone consists of ten sine waves with frequencies separated by octaves; the intensity of each is a gaussian function of its separation in semitones from a peak frequency, which in the above example would be B(4).)

The scale as described, with discrete steps between each tone, is known as the discrete Shepard scale. The illusion is more convincing if there is a short time between successive notes (staccato or
marcato instead of legato or portamento). As a more concrete example, consider a brass trio consisting of a trumpet, a horn, and a tuba. They all start to play a repeating C scale (C-D-E-F-G-A-B-C) in their respective ranges, i.e. they all start playing C's, but their notes are all in different octaves. When they reach the G of the scale, the trumpet drops down an octave, but the horn and tuba continue climbing. They're all still playing the same pitch class, but at different octaves. When they reach the B, the horn similarly drops down an octave, but the trumpet and tuba continue to climb, and when they get to what would be the second D of the scale, the tuba drops down to repeat the last seven notes of the scale. So no instrument ever exceeds an octave range, and essentially keeps playing the exact same seven notes over and over again. But because two of the instruments are always "covering" the one that drops down an octave, it seems that the scale never stops rising.

Jean-Claude Risset subsequently created a version of the scale where the steps between each tone are continuous, and it is appropriately called the continuous Risset scale or Shepard-Risset glissando. When done correctly, the tone appears to rise (or descend) continuously in pitch, yet return to its starting note. Risset has also created a similar effect with rhythm in which tempo seems to increase or decrease endlessly.[2]

[edit] Shepard scales in music

Although it is difficult to recreate the illusion with acoustic instruments, James Tenney, who worked with Roger Shepard at Bell Labs in the early 1960s, has created a piece utilizing this effect, For Ann (rising). The piece, in which up to twelve closely but not quite consistently spaced computer-generated sine waves rise steadily from an A pitched below audibility to an A above, fading in, and back out, of audible volume, was then scored for twelve string players. The effect of the electronic work consists both of the Shepard scale, seamless endlessly (rising) glissandos, and of a shimmering caused by the highest perceivable frequency and the inability to focus on the multitude of rising tones. Tenney has also proposed that the piece be revised and realized so that all entrances are timed in such a way that the ratio between successive pitches is the golden mean, which would make each lower first-order combination tone of each successive pair coincide with subsequently spaced, lower, tones.

An independently discovered version of the Shepard tone appears at the beginning and end of the 1976 album A Day At The Races by the band Queen. The piece consists of a number of electric-guitar parts following each other up a scale in harmony, with the notes at the top of the scale fading out as new ones fade in at the bottom. Lose Control by Missy Elliott also seems to feature an ascending Shepard tone as a recurring theme (via the sampled synthesizers from Cybotron's song "Clear"). "Echoes", a 23-minute song by Pink Floyd, concludes with a rising Shepard tone. The Shepard tone is also featured in the fading piano outro to "A Last Straw", off Robert Wyatt's 1974 opus Rock Bottom.

Douglas Hofstadter in his book Gödel, Escher, Bach: An Eternal Golden Braid explains how Shepard Scales can be used on Bach's Endlessly Rising Canon for making the modulation end in the same pitch instead of an octave higher.

Another independent discovery, in classical music, occurs in the Fantasy and Fugue in G minor for organ, BWV 542, by Bach. Following the first third movement of the Fantasy there is a descending pedal bass line under a chord sequence which traverses the circle of fifths. The gradual addition of stops up to full organ sound creates something akin to a barber-pole pattern with an illusion of ever-deeper descent, even though the bass line actually skips octaves.

An example in modern culture of the Shepard tone is in the video game Super Mario 64; the tone accompanies the never-ending staircase.[3]

Antonio Carlos Jobim's Waters of March has descending orchestration that is intended to represent the continual flow of water to the ocean; the effect is very much like Shepard tones.
[edit] Example

A Shepard-Risset glissando

• Problems playing the files? See media help.

[edit] References

2. ^ Risset rhythm
3. ^ YouTube: "Super Mario 64: Endless Stairs Glitch and Ending"

[edit] External links

• The partials of a Shepard tone
• Audio demonstration of the discrete Shepard Tone
• Demonstrating an audio example of a continuous "endlessly descending" tone
• Demonstration of discrete Shepard tone (requires Macromedia Flash)
• Visualization of the Shepard Effect using Java
• Demonstration of the Shepard Scale of the Infinite Staircase in Super Mario 64
• Freeware Shepard tone generator (VST/AU Plugin)

The Use of Tonal Frequencies to Enhance, Heal, & Rejuvenate

[Editor's Note: This is an important article to read and study carefully. I suggest that you print it out so you can review it at your leisure and allow the full implications of this information to sink in. One of the 'secrets' of the universe, is the creative application of sound frequencies. John Worley Keely discovered this creative use of musical frequencies in the late nineteenth century and accomplished amazing feats that defied conventional physics and confounded the academicians of his day.]

A film was made in the Himalayas in the 1930's showing a group of Tibetan monks, who with the use of ordinary Tibetan musical instruments, would gather into a pie-shape configuration and direct their playing towards a huge boulder that was located on the ground roughly one hundred fifty feet away and at the base of sheer rising mountain wall. About three minutes after the 'concert' began, the boulder began to vibrate and lift off the ground. A moment later, it shot up about 150 feet into the air and landed on a ledge above it, where other monks were using the boulders to seal the entrance of meditation enclaves that they had cut into the sides of the mountain.

Today, many people are enjoying a brisk business over the internet selling supplemental products or liquids that are 'encoded' with "special energies". Those "energies" are usually very specific sound, light, or color frequencies, or sometimes a combination of same. You can do your own "encoding" of food, water, or even gasoline, and reap the benefits without shelling out $40, $50, or $60 bucks for a 16 oz bottle of Wonder Elixir. You can also do many other things in a creative vein using the appropriate sounds or combination of sound frequencies. But first, you need to acquire a basic understanding of the principles involved in the creative application of sound energies and this article will serve as a good primer in that regard. In addition to Philip Ledoux's info, I'll be adding some additional explanations from the book, Healing Codes for the Biological Apocalypse referenced below, to further expand your education on this subject.

If you don't already own a frequency generator, you can get a free software download from NCH called the NCH Tone Generator. I'll be uploading another article soon which will explain the different types of frequency generators available and how to use them.

As synchronicity would have it, I was talking with a very helpful woman yesterday who I'll identify as "DRE". She put me onto a healing Shinto chant from Japan that was producing remarkable results for her. Using specific vocal sounds, uttered in a specific order, is another way to access the creative power inherent in sound. You can find her e-mail to me about the Shinto chant at the bottom of this article.

You should notice that as the Dark Side attempts to draw in their net and consolidate their New Order agenda, the Light Side counters with more and more "new stuff" to help you meet the challenge. This is one of the biggest reasons you should avoid wasting your time with people who peddle Doom & Gloom scenarios or attitudes of defeatism. The Law of Attraction is always at work, as the recent video "The Secret" makes clear. You attract to yourself, the same energy which you put out. Think negative, you get negative. Think positive, you get positive-and bounty.

Solfeggio, when used by musicians, means the ability to sight read music and sing the
notes accurately (pitch wise) without the use of a musical instrument. For the purpose of this article, Solfeggio refers more to the notes of the diatonic music scale, known by everyone as "Do, Re, Mi,. etc. ..Ken]

By Philip N. Ledoux
http://educate-yourself.org/pnl/solfeggio01dec06.shtml
December 1, 2006

Ken,

I have been a musician most of my life, and math has been one of my favorite subjects since primary school days. As a 26 year old man, the Navy taught me that there is more to electricity and electronics than the "on-off" switch. When I read Dr. Len Horowitz & Dr. Joseph Puleo's "Healing Codes for the Biological Apocalypse" which introduced the Solfeggio Frequencies, I was hooked.

Just recently, I encountered the extended Solfeggio Frequencies (I'm not certain whether it was a joint Horowitz & Puleo effort, or individual effort) and the suggested health possibilities are astounding. Gradually, other possibilities developed in my mind (and maybe others have done the same). I try not to plagiarize others, yet I seem to get inspirational ideas beyond the work of others whom I've encounter. Do realize that all the presentations I make here are the work of Horowitz & Puleo and others. All that I am currently attempting to do is to extend the application of the Solfeggio Frequencies.

TPTB give me a difficult time via the internet; thusly these pages will be sent to you as #1 of 6, #2 of 6, etc. I seem to have less failed deliveries this way. The Solfeggio "wheels" of necessity cannot be sent as a text file. They were developed in MS Word. Sometimes Word-documents deliver without a problem, other times they are garbled. Kindly give me some feed-back as to success or failure of delivery. Do realize that the "wheels" are not of my generation, I merely re-invented the wheel in MS Word so that my archival system is consistent.

Part 1 is this cover letter; part 2 is the background as I understand and collected information about; part 3 is the dowsing verification of ideas I had about the Frequencies (in the dowse, the format is: my original text with dowse-answers in braces and hopefully those dowse-answers are in a contrasting color); parts 4 and 5 are the redrawing of the Solfeggio wheel in MS Word; and part 6 is nothing more than the math work of developing the primary harmonics developed. Parts 4 through 6 are as an attachment because it is the only means I have of forwarding the drawings.

I shared preliminary ideas with friends, who in turn suggested that I forward the materials to specific individuals. It has taken a bit of time to put it all together logically. Tim, the dowser does not reflect my opinion about the difficulty of beating TPTB at their game of control. I personally have had close encounters with the enforcers of TPTB and am still "gun shy." My logical mind says that if we are able to apply the Solfeggio Frequencies as my original dowse lead me to, those individuals could be prime targets and live miserable lives should they take the results into high profile. The reason I try to get wide publication for even preliminary information is the relative safety of many minds and individuals working on similar (if not identical) solutions; TPTB have no clues as to whom picked up on the ideas presented when published, thusly nothing to work with as counter-actions until the end results surface.
In Healing Codes for the Biological apocalypse Dr. Leonard G. Horowitz and Dr. Joseph S. Puleo published the Secret Solfeggio Frequencies. Basically it is the "Doe, Rae, Mi, Fa, So, La, Ti, Doe" diatonic scale which we all learn in the first few grades of school.

Over time, the pitch of this diatonic scale has changed and somehow Horowitz and Puleo found the original pitch frequencies.

In the Solfeggio, "Ti" is missing and what we call "Doe" was known as "Ut". Here are the original pitch frequencies of these six notes:

1. Ut = 396Hz which reduces to 9 [reducing numbers: 3+9 = 12 = 1 + 2 = 3 ; 3+ 6 = 9]
2. Re = 417Hz which reduces to 3
3. Mi = 528Hz which reduces to 6
4. Fa = 639Hz which reduces to 9
5. Sol = 741Hz which reduces to 3
6. La = 852Hz which reduces to 6

They also state that Mi is for "Miracles" or 528Hz - is the exact frequency used by genetic engineers throughout the world to repair DNA.

Another interesting tidbit that the authors included as a musical scale with words, from the work of John Keely; where Keely related the hues (not pigment colors) of light related to musical notes. On the "G-Clef" with "C" being the first line below the staff and continuing up the scale and up the staff:

C = Red = Tonic
D = Orange = Super Tonic
E = Yellow = Mediant
F = Green = Sub Dominant
G = Blue = Dominant
A = Indigo = Super Dominant, Sub Mediant
B = Violet = Leading Tone, Sub Tonic
C = Red = Octave

Also included with this chart was another from the Dinshah Health Society:

Red = 397.3Hz Closest Note: G = 392Hz
Orange = 430.8 Closest Note: A = 440
Yellow = 464.4 Closest Note: A# = 466
Lemon = 497.9 Closest Note: B = 494
Green = 431.5 Closest Note: C = 523
Turquoise = 565.0 Closest Note: C# = 554
Blue = 598.6 Closest Note: D = 587
Indigo = 632.1 Closest Note: D# = 622
Violet = 665.7 Closest Note: E = 659
Purple = 565.0 (reverse polarity) Closest Note: A# and E = 562 (both reverse polarity)
Magenta = 531.5 (reverse polarity) Closest Note: G and E = 525 (both reverse polarity)
Scarlet = 497.9 (reverse polarity) Closest Note: G# and D = 501 (both reverse polarity)

From www.lightwithin.com this additional information is gleaned:

The Six Solfeggio Frequencies include:

- UT - 396 Hz - Liberating Guilt and Fear
- RE - 417 Hz - Undoing Situations and Facilitating Change
- MI - 528 Hz - Transformation and Miracles (DNA Repair)
- FA - 639 Hz - Connecting/Relationships
- SOL - 741 Hz - Awakening Intuition
- LA - 852 Hz - Returning to Spiritual Order

The basic Solfeggio frequencies totaled six (6). Horowitz continued his search through the years and extended it to 9 frequencies. Most everyone is familiar with the Star of David which uses two triangles (inverted to each other) inscribed within a circle. If one uses the same approach for three triangles overlapping (no inversions) and space them approximately 40 degrees apart around a circle, some amazing relationships appear. Orient the circle with one triangle apex at North or zero degrees. Label that 396. At the next clockwise point label 417, the next 528, the next 639, the next 741 and the last 852. You now have the basic six Solfeggio frequencies.

The numbers we have so far added to our circle of numbers have a pattern to them:
Any number connected by a line, for example 396 and 639, if you take the smaller number and move the last digit to the first position, you have created the line-linked number. [move the 6 of 396 to the front and you have 639] Likewise 417 by moving the 7 creates 741, both numbers are line linked. And 528 by moving the 8 creates 852 both numbers line linked.

As created so far, we have 3 missing numbers, but they can easily be created by applying this moving of digits positions. Take the triangle that has 396 and 639. If we take the 9 and move it to the first position we have 963, which is one of the extended Solfeggio frequencies! Thusly we can now continue the circle one more position by adding 963. Applying this same logic to the 417 and 741 triangle to fill in the missing number we move the 1 to the first position to develop 174 which is another extended Solfeggio number. Continuing clockwise add 174 to the number sequence. And the 528 and 852 triangle if we move the 2 to the first position we have 285, the final missing extended Solfeggio number. So elegantly simple.

Take a piece of paper and lightly grid it off for a large "tic-tac-toe" game. Across the top place the smallest number in the upper left corner; continue horizontally with the line-linked (triangle) numbers 417, 741. In the middle line, left position place the second in clockwise numbering (285), continue horizontally with its line-linked numbers 528, 852. The last horizontal line starts 396 and continues 639, 963. Now for some surprises. Compute the difference between all the vertical row numbers; they are all 111. Compute the differences between the horizontal row numbers; left row and center row all = 243 and center row to right row differences are all 324. And here we go again with the move the last digit to the first position move the 3 of 243 to the front and we have 324.

dif: 111 dif: 111 dif: 111
285 <- dif: 243 -> 528 <- dif: 324 -> 852
dif: 111 dif: 111 dif: 111
396 <- dif: 111 -> 639 <- dif: 324 -> 963

The end result of all this or summation is the simple fact that you need to remember only two numbers: 174 and 111, and remember the principle of 3 overlapping triangles so that their points are about 40 degrees apart creating nine points around a circle and moving the last digit to the first position.

Harmonic Sums
Once the diagram is set, and 174 is placed in any starting position, move the last digit to the first position creating 417 which is the next number (clockwise) in the triangle, then move 7 to the first position creating 741 which is the last number in the triangle. This connects 174, 417 and 741. The next step is to add 111 to 174 which gives 285; this becomes the next clockwise number from 174. Now move the last digit to the first position creating 528 of this triangle and so on to complete the total 9 frequencies and their relative positions. Logical, sequential and amazingly simple!

One does not need to be a number genius, nor a math PhD to recognize that there must be something special to this numbering sequence of the extended Solfeggio numbers. Horowitz places 528 in the center of the circle with the words "LOVE" and "THANKS." I am not thoroughly conversant with the application of these numbers. Horowitz and Puleo state that these numbers are the key to creation and destruction. On other sites, it is implied that one should apply the real frequencies to the corresponding points on the circle we constructed, I assume a metallic plate. With the equipment that most people have available, only one frequency at a time can be generated. Thusly, 9 different frequencies at their appropriate points for equal amounts of time. I personally wonder what would happen if one would apply 9 frequency generators to their respective points all operating simultaneously.

Philip N. Ledoux

Larger print out of this graph

*******
[From Ken Adachi: The following note was sent by Philip Ledoux to Tim H. who cross checks Phil's dowsing answers. The bracketed answers (or comments) shown in blue are those of Tim H.]

---------------------------------------------------------------------------

Tim,

I hope you have the time to put into a big request from me. I am sending you a basic introduction for anyone who hasn’t read Horowitz and Puleo and their Solfeggio research. As it continues, some amazing relationships become visible (at least to me). I’m doing a bit of guess work, because I have not kept up to date on their research and latest books; I’m only up to their 1999 publications. In a site I landed onto about their work, it implies that these Solfeggio frequencies heal, energize water, etc. etc. Horowitz is operating a healing spa in Hawaii apparently which uses the frequencies on the water he uses.

When I recognized the inter-relationships of numbers (which the intro points out), my brain engaged. Because I was guessing, I did some dowsing and my guessing was confirmed; and per usual, on and on the dowsing went. Actually, only about 10 minutes, but I stopped because I realized what the incoming answers were leading to! So, please can you dowse in your own manner, working around some of my outline and questions.

Apparently you take a metallic disk and apply the written numbers frequency to that point (The wheel is supposed to arrive as an attachment to a message). That would be simple enough if one had the generators and the frequency checkers – I would assume that it has to be accurate as “close enough” is not going to cut it for this work. And apparently nobody has tried to use 9 frequency generators simultaneously.

I would imagine that there are some simple chips and by using precision parts along with adjustable variables (that lock) could be fabricated for the job and not be overpriced (minus the labor cost). What I got for an answer was that very little power was needed via 9 generators simultaneously (AG?) [Anti Gravity]

Is this the key mechanism to make AG work? [yes].

Can disks be impressed with only one or a few frequencies to generate “good fortune,” happiness, counter depression, add energy, etc.? In other words can a disk be designed via the frequencies for a specific desired end result? [yes]

And what might the combinations be? [A very precise word to help identify the intended purpose of the frequency for the maker/user.]

Would a specific end result disk require the center to be a different freq. than the wheel? [yes]

Can this “disk” be incorporated into an orgonite creation? [yes]

Does it have to be preprogrammed, or be programmed while curing? [programmed while curing is the only method that will work properly]

Are we onto something that can bypass the gas pump? [yes]
Can such a disk be “programmed” to increase mileage 10x, 100x?? [yes]

Is it placed on the carburetor or fuel injection pump, or where? [it should be in the fuel line near the point of usage, needs to contact the fuel to enhance the fuel and the mechanical aspects of the engine, in a synergistic manner]

What method of attachment is used? [a very small programmed disk could be inlaid into the fuel line.] Can these special purpose disks be used like magnet therapy? [yes]

I visualized a 6 foot to 10 foot disk with 9 generators using a central wet battery and a seat; was I day-dreaming or is it plausible with sweat and frustration? [I check that this is usable for the purpose you have in mind]

Or is all this merely an “overly active imagination” which many think I am working with.? [I check this is not wasteful thinking]

I don’t want to distribute info prematurely, but neither do I want to give TPTB very much time to organize. [Distribute as soon as you feel confident about it.]

In the book I have and the sites I’ve visited they emphasize that the (basic and extended?) Solfeggio frequencies have been used down through history to create and destroy, and the Almighty used them for creation. Can the correct combination of frequencies be used like Keely did with his disintegrator? [yes, there is protection now in the heart of mankind to prevent the destructive use of this tech. by a few bad men, and so it safe to make public]

[Very good work, Philip. Keep it up!..Tim]

******

Date: Sat, 02 Dec 2006
From: DRE
To: Editor
Subject: That Magical Healing SingingChant

Greetings Ken,

Here are the words to the ancient magical-like HEALING chant-song-prayer my friend shared with me several days ago. Given to her by Shinto priest Hideo Izumoto in a recent gathering. It is powerful! You SING the words slowly, deliberately. First time I sang it, I felt a very labored strained feeling in my chest, like a very heavy weight, a pulling, like lifting a thousand pounds. It was soooo HARD to just get through it. In two days that labored, almost painful feeling was gone. Checking with my friend, I found she had the same experience, except she also felt pains in her back, knee and other places. We did a 3-way conference and called priest Hideo about it. He congratulated us and confirmed what we figured out: that the pain was a sign that the singing was healing us, clearing away imbalances within.

On the 3rd day, while I was in a park doing my daily SunGazing at sunrise, a tiny (humming?) bird chimed in with me. Perching itself on a nearby branch close to me,
singing out its leetle heart. By my 4th day of singing the chant (I do it throughout the
day; it is so pleasurable), I noticed to my amazement I no longer needed to wear my
glasses when driving. Plus my nearsighted vision has become perfect. The same thing
occurred with my friend! She no longer needs to wear her glasses. Before we even knew
about this chant, we both had prayed daily for "Clarity," amongst other things.

Since I started chant-singing 6 days ago, I now wake up feeling completely rested and
alert. The chant-singing apparently diminishes/removes anxiety. I am confident that as
I continue, my imbalances on all levels will be smoothed away. The words seem to
HELP EVERYTHING. You can direct the energy to any part of your body, or any
situation. I read on one of the sites that the words were brought to humanity as a gift,
brought by angels.

Call her up and she can play it for you while you record it on your machine, etc. He has
I think at least two dvds. You may call him too; his cell number is published:

Here are the words (The dashes --- indicate take a breath. The last syllable, ³Kay² is
drawn way out):

Hi Fumi --- Yo I Mu Na Ya --- Kotomo Chi Lo Lane
Shi Ki Lu --- Yu I Tsu Wanu --- So O Ta Ha Kumeka
U O E --- Nisali Hete --- Nomasu A Se E Holeke

Pronunciation (spelled the way it sounds in Japanese):

Hee FuMee -- Yo Eee MuUu Na Ya -- KoToMo Chee Lo LahNay
Shee Kee Lu -- Yu Eee TsuU WaNu -- So O Ta Ha KuMayka
U O Ay --NeeSahLeEee HayTay --NoMaSu Ah Say Ay Holay-KAYYY..

Meaning of the Chant PrayerSong

(Hi Fumi --- Yo I Mu Na Ya --- Kotomo Chi Lo Lane):
We are gods and creators. We create everything in the Universe for us and it belongs
only to us and forever.

(Shi Ki Lu --- Yu I Tsu Wanu --- So O Ta Ha Kumeka):
We practice Freedom, Truth, Love, Beauty and Happiness, Advancement and actually
becoming God Beings.

(U O E --- Nisali Hete --- Nomasu A Se E Holeke):
We live together forever, for our happiness and advancement. Thank you God, for every
one, every thing, and for me.

Here are some related links
http://www.coloradoacupuncture.com/shinto.html

.. and a free downloadable booklet (interviews Hideo)

and Hideo's book, "The 47 words of GOD" chant
http://www.amazon.com/47-words-GOD-chant/dp/B00000IBKD
Hideo's Prayer
http://educate-yourself.org/cn/hideoizumotoprayer03dec06.shtml

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Off the subject, here is that other site I mentioned When I was looking up info on Hideo, I came across the following site, which groups on one page, the unusual dramatic things silently occurring with all the planets in our solar system. The implication being that something MASSIVE is happening; things are moving to some climax. Just WHAT? And izzit related to all the talk about the Mayan-year 2013?:

Sincerely,
DRE

***

Date: Mon, 11 Dec 2006
From: Philip N. Ledoux <oldmanfromnh@yahoo.com>
To: Editor
Subject: The Japanese Healing Chant addition

Hideo Izumoto desires to change the world (for the betterment of mankind); somehow he discovered the secret. One starts with changing an individual who in turn changes a family which in turn changes a community; and thusly seeds planted throughout the world eventually changes the world. So simple, yet so profound. In bringing about this change Hideo utilizes an ancient Shinto chant which in Western Culture brings about miraculous cures. This is all part of a necessary change in an individual. If we are sick, ill or diseased, how can we make changes in ourselves say nothing about changing our families?

Here is the chant as published at many internet sites:

"The 47 Words of God" Chant -

HI FUMI... YO I MU NA YA... KOTOMO CHI LO LANE
"We are Gods and Creators. We create everything in the Universe for us and it belongs only to us and forever."

SHI KI LU... YU I TSU WANU... SO O TA HA KUMEKA
"We practice Freedom, Truth, Love, Beauty, Happiness, Advancement and actually becoming God Beings."

U O E... NISALI HETE... NOMASU A SE E HOLEKE
"We live together forever for our happiness and advancement. Thank you, God, for everyone, everything and for me."

If one has translated languages, that person is well aware of linguistic problems that are as old as mankind itself. How do you write another language to sound correctly in your own language? We pride ourselves in our English language, and rightfully so; but we should also consider how our language developed and its uniqueness. Among linguistics there is the old joke: German has a thousand rules with only a dozen exceptions, but
English has only a dozen rules with a thousand exceptions. Yes, we indeed have a unique language, and even our phonetic pronunciation is unique. All the romance languages (basically European, or nearby to Europe) pronounce the vowels A, E, I, O and U the same yet is different than for us English speaking people; thusly there has developed (via this majority) an international phonetic alphabet or sound-bites used to convert non-romance based languages into near equivalent sounds. The problem is that it is used universally, yet English speaking people rarely are aware of this difference. I will attempt to "translate" the translated sounds in the "47 Words of God" chant so that the average American-English speaking person can recreate the Japanese words more correctly.

**HI FUMI... YO I MU NA YA... KOTOMO CHI LO LANE**
Hee Foo-Me . Yoh E Mu Nah Yah . . . Ko-Toe-Moh Chee Low LahNay

**SHI KI LU... YU I TSU WANU... SO O TA HA KUMEKA**
She Key Lou . . You E t'Sue Wah-Noo . . . Soh Oh Tah Hah Koo-May-Kah

**U O E... NISALI HETE... NOMASU A SE E HOLEKE**
You Oh Ah . . Knee-Sah-Lee Hay-Tay . . . No-Mah-Sue Ah Say Ah Ho-Lay-Kay

I think the reader can quickly recognize why I take the time to re-translate the translation-sounds. Obviously we English speaking people do pronounce very uniquely the written language as compared to the remainder of our romance-language brethren.

If we somehow were to be "dropped" into Japan and entered a school or a monastery which started its day with the ancient Shinto "47 Words Of God" chant, even though we had no clues as to its meaning, we would receive healings. This is because of the tones, overtones and harmonics of the chant AND the word sounds combining. Apparently this is why all the sites which publish this special healing chant, include the international phonetic translation. The only missing ingredient are the musical clues or "sheet music" to correctly "sound" the Japanese words. Is there any reader who knows the chant, who will send me the musical notes or scale tones that go with this chant? When I receive that, I'll try to write up something for the average person to "hen-peck" on some kind of keyboard or instrument to correctly intonate this healing chant correctly. (I have some musical training so don't worry about style, correctness, etc.) And if I've made phonetic errors in my translation of the translation, kindly let me know.

Philip N. Ledoux
oldmanfromnh @ yahoo . com

**Comments**

----- Original Message -----  
From: Services4Health@aol.com 
To: Philip Ledoux  
Cc: Ken Adachi 
Sent: Monday, December 04, 2006 
Subject: Solfeggio Frequencies 

Hey Phil and Ken,
I'm reading and thoroughly enjoying the post on Solfeggio Frequencies.

You guys might want to check out my Len Horowitz thread on The Women Warriors.

I have uploaded the **Holy Harmony CD** as an mp3 file which has all those frequencies in the music, while the monks are chanting out the Creator's name.

Len also has his 3e symbol, along with that which he describes as **The Perfect Circle of Sound**.  

I have his newest book there in PDF format in the thread for download too. Scroll on further down, and you'll see the 3e symbol and MP3 download of Holy Harmony. After playing that Holy Harmony several times, I can still hear it in my head even when it's not physically playing.

I had a special HHG made for Len, by one of the orgone vendors, using his technology.

I had a 3-sided tetrahedron pyramid made with orgone charged water on the CB, Holy Harmony playing while it was curing, and then the 3e symbol put on the sides.

I'll be making all of my orgone this way now, except when charging on the CB, I'll have a 3e symbol on the container as well as being charged with orgone.

Also, check out the pics on my post where Len Horowitz had Dr. Emoto take pictures of the 3e and Holy Harmony charged water, you'll see how powerful it really is. Now take that charged water and put in orgone. WOW!!

Before I gave Len his HHG, I still had it in the car, when my husband and I got pulled over by a cop. A headlight had shorted out. By all indications, my husband could have gotten in serious trouble because he still had an out-of-state license. The cop assumed we were new to the area, when in fact we had been here over three years now. We had current plates and by running them, the cop would have known that we have been here longer. But... he didn't catch that at all. Totally overlooked it. The power of the orgone blinded him. My husband also didn't have a current copy of insurance to show him either.

The cop just gave him a warming which didn't have a fine on it, but to take it in with proof of insurance and no money was ever spent on fines. We did have current insurance, but my husband didn't put it in the car yet.

The POWERFUL orgone coming Len's special HHG was putting out purple auras. That cop was really extra nice to us. We both were shocked. He was very talkative and friendly, which is rare these days. My husband could have gone to jail, honestly.

This is just one of my experiences with powerful orgone.

Anyhow, check out the post on The Women Warriors, okay? Download the Holy Harmony and enjoy!

~Donna C.
I saw the "The Use of Tonal Frequencies to Enhance, Heal, & Rejuvenate" article.. and right away thought of brainwaves (which goes even a step further than tonal frequencies)... take a look at http://bwgen.com as well as http://centerpointe.com/

Through brainwave entertainment of theta and delta waves, you can go into a deeper meditative state than an experienced meditator. Threshold of the Mind (http://www.amazon.com/Thresholds-Mind-Bill-Harris/dp/0972178007) written by the creator of the Holosync (Centerpointe) Program is a really good look into various studies of brainwave entertainment as well as meditation in general. (sorry for the very "point form" like email.. just @ work and trying to say as much as possible in as little time as possible.. if you have any questions.. email me..)

Lukasz.