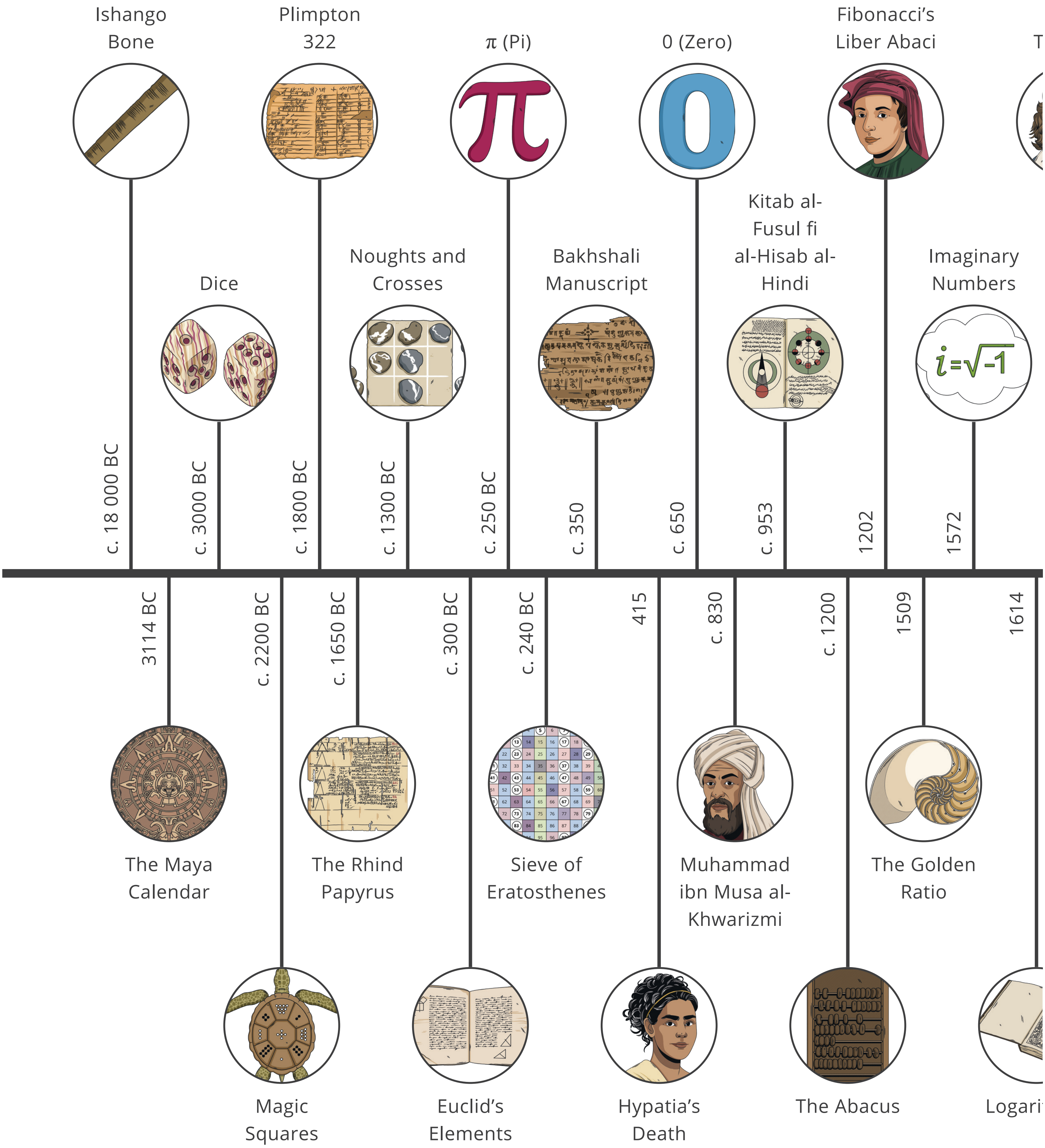
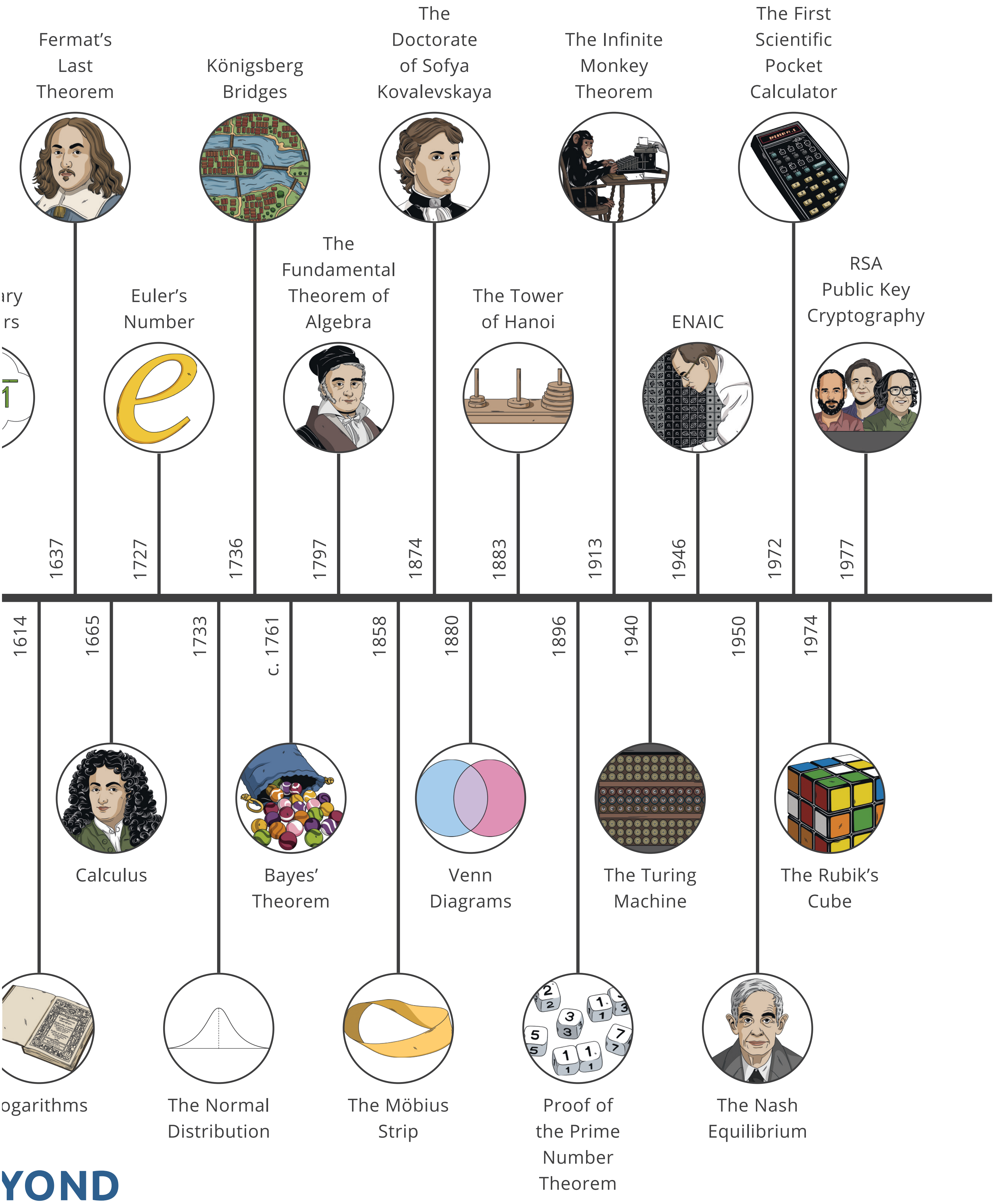
The History of Maths **Timeline**





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1974
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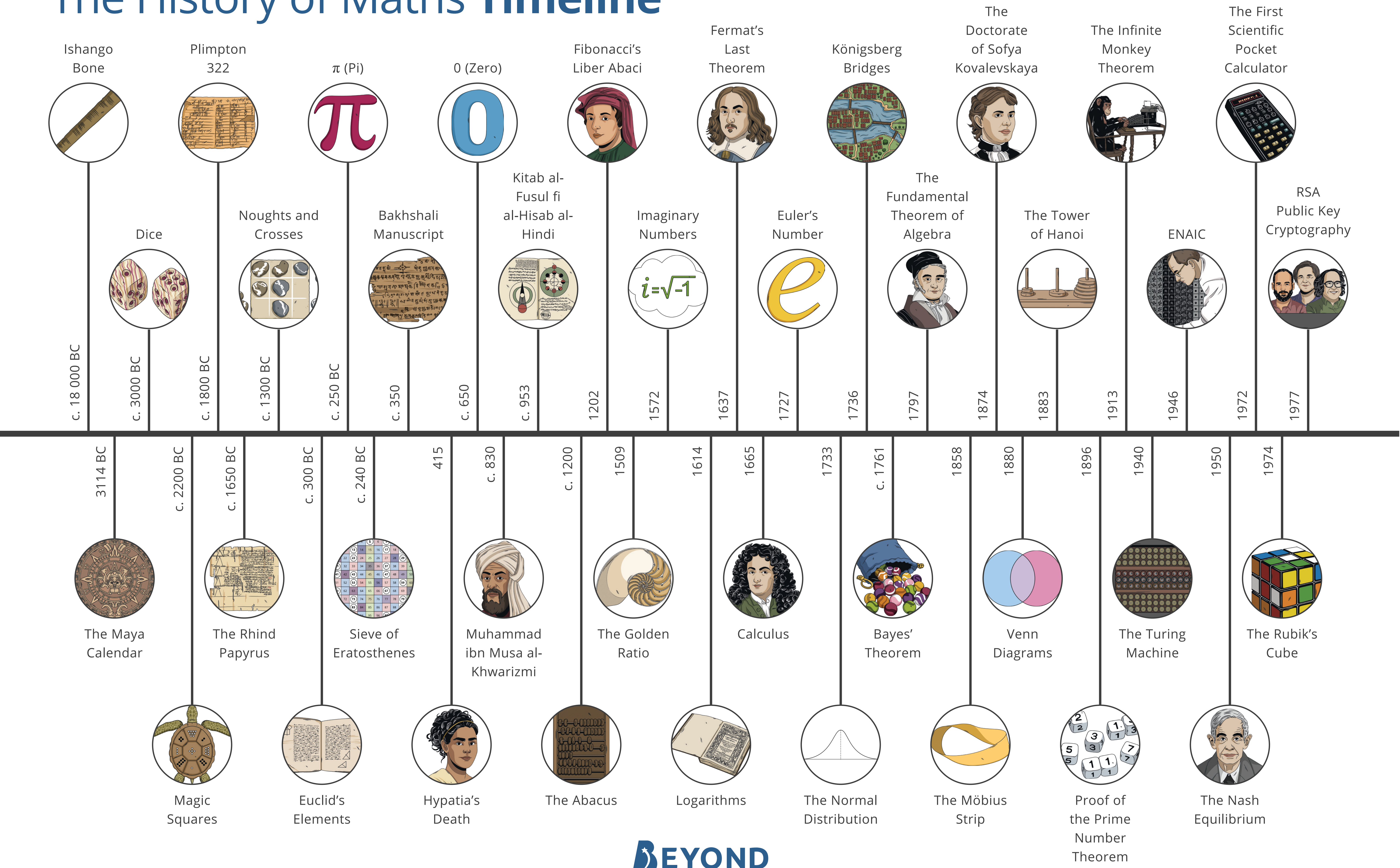
YOND
MATHS

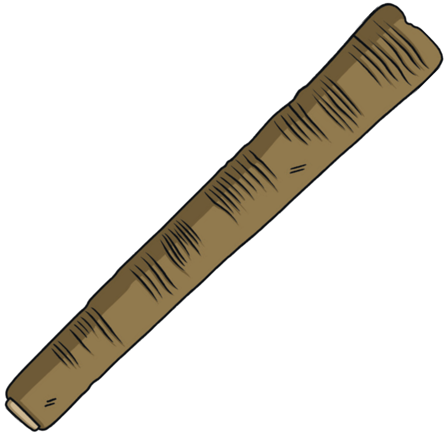
The History of Maths **Timeline**



BEYOND MATHS

c. 18 000 BC — Ishango Bone

First discovered in the Democratic Republic of Congo in 1960, the Ishango bone is a baboon bone with markings etched into it. The meaning of the markings is not entirely clear, though there is a column that features prime numbers. Some mathematical historians think it is a simple tally stick; others think it is about doubling and halving; some believe that it may be a lunar calendar used to track menstrual cycles.



BEYOND

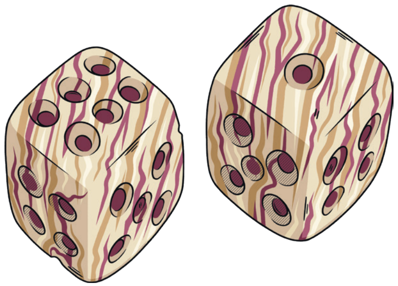
3114 BC — The Maya Calendar

The Maya calendar was a system of calendars used in Mesoamerica, an area that now covers many countries including Mexico, El Salvador and Nicaragua. It is based on a ritual cycle of 260 days and a year of 365 days. Together, these made a cycle of 18 980 days (52 years). The Maya carved figures and important dates on stone pillars called stelae. To accurately describe dates, they used a Long Count from a base date. The first Great Cycle (5125 years) after the start of the Long Count ended on 21st December 2012, leading some people to theorise this would be the end of the world.

BEYOND

c. 3000 BC — Dice

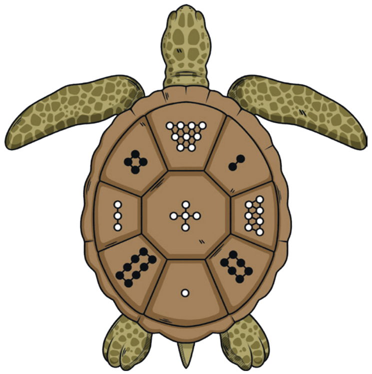
The oldest known dice were excavated with a backgammon set from the Burnt City in Iran. In ancient times, it was believed that the gods controlled the outcome of dice rolls so dice were often intrusted to make crucial decisions. However, they were also used for games just like today! Many games are mentioned in religious texts and manuscripts. While 6-sided dice in the shape of a cube are considered standard, there are also examples of 4-sided dice as far back as the Romans and 20-sided dice from the Egyptians.



BEYOND

c. 2200 BC — Magic Squares

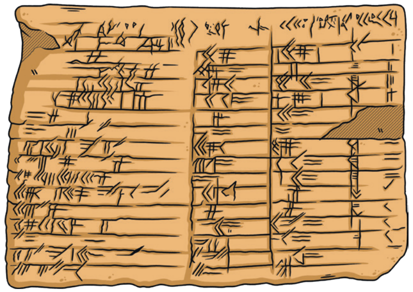
First mentioned in China, magic squares are made up of n^2 cells filled with different integers. Each row, column and diagonal have the same sum. The first magic square we have found evidence for is called the Lo Shu Square. Legend tells us a tortoise came out of the Yellow River with the pattern of the Lo Shu Square on its back. The Emperor recognised the pattern as one that he saw in the stars each night and realised that this was a divine tortoise. The Lo Shu Square contains the integers 1 to 9 and each row, column and diagonal sums to 15.



BEYOND

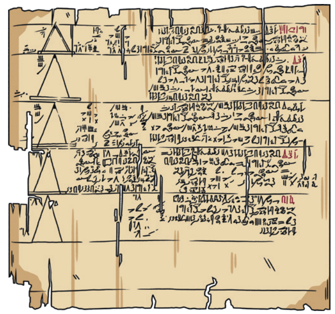
c. 1800 BC — Plimpton 322

This is an underwhelming name for a very exciting object! Plimpton 322 is a Babylonian clay tablet with numbers in cuneiform script etched into it. They are arranged into a table with 4 columns and 15 rows. The fourth column just contains the column number but the first three are Pythagorean triples. These are sets of 3 integers that could represent the sides of a right-angled triangle – they satisfy the relationship $a^2 + b^2 = c^2$. For example, 3, 4 and 5 are a Pythagorean triple because $3^2 + 4^2 = 5^2$.



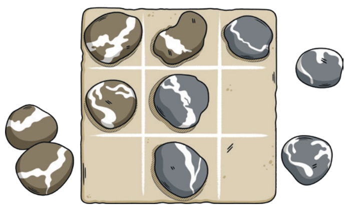
c. 1650 BC — The Rhind Papyrus

This scroll is about 30cm high and 500cm long and was found in a tomb on the east bank of the Nile. It contains the earliest known mathematical symbol: a plus sign denoted by a pair of legs. It contains mathematical problems including fractions, algebra, the geometry of pyramids and mathematics for accounting. It also includes Problem 79 which translates to: “Seven houses contain seven cats. Each cat kills seven mice. Each mouse has eaten seven ears of grain. Each ear of grain would have produced seven hekats (measures) of wheat. What is the total of all of these?”.



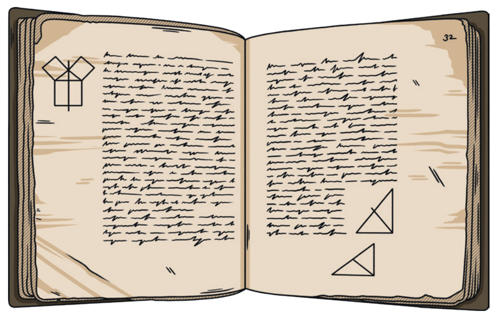
c. 1300 BC — Noughts and Crosses

Games similar to noughts and crosses, or tic tac toe, have been around for longer than seems possible! The rules of the game in ancient Egypt are likely to have varied from modern rules but games like this played an important role in day-to-day life – game boards have been found on roofing tiles! In an early variation, each player only had three pieces and had to move them around to keep playing. With this beginning point, it is incredible to think of the game OXO developed in 1952 by Sandy Douglas. Designed for the EDSAC computer, it was one of the first video games.



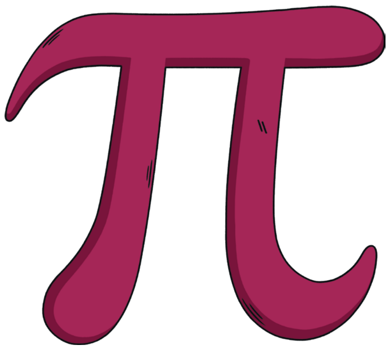
c. 300 BC — Euclid’s Elements

Euclid of Alexandria is often referred to as the founder of geometry and his most famous work, Euclid’s Elements, was the root of mathematical teaching for 2000 years. It inspired a number of future mathematicians and scientists: Hypatia’s life’s work was to preserve the text; Sophia Germain studied The Elements by candlelight; and Einstein received the book as a gift – inspiring him to study geometry.



c. 250 BC — π (Pi)

The ratio of the diameter of a circle to its circumference has been known to be around 3 for a long time – it's even mentioned in the Bible (1 Kings 7:23)! However, it wasn't until the Greek mathematician Archimedes that an accurate range for the value was found – between $\frac{223}{71}$ and $\frac{22}{7}$. Now, we know more than 60 trillion digits of π – the digits never end and seem to have no pattern.



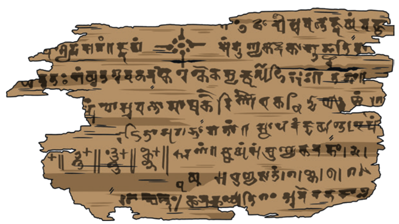
c. 240 BC — Sieve of Eratosthenes

The Sieve of Eratosthenes is an efficient algorithm to find prime numbers. To find all the prime numbers under 100, you only need to run the algorithm 4 times. The algorithm considers the multiples of each number in turn and eliminates them. You only consider the multiples of numbers that haven't been eliminated; in other words, prime numbers.

	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

c. 350 — Bakhshali Manuscript

This ancient mathematical text, written on birch bark, is only a fragment of the original manuscript. It is thought to be the oldest manuscript showing Indian mathematics. It includes the following problem, which has infinite solutions: "One person possesses seven asava horses, another nine haya horses, and another ten camels. Each gives two animals, one to each of the others. They are then equally well off. Find the price of each animal and the total value of the animals possessed by each person."

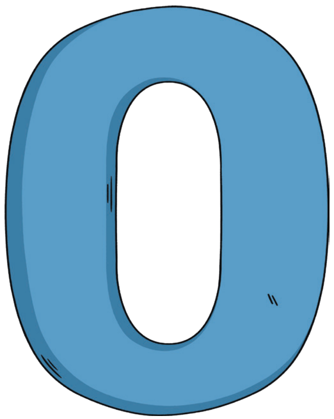


415 — Hypatia's Death

Hypatia was a prominent mathematician and philosopher who lived in Alexandria, Egypt. In March 415, she was brutally murdered by a mob of Christians. Her murder shocked the empire as philosophers had been seen as untouchable for so long. The murder of a well-known female philosopher and mathematician destabilised society itself.

c. 650 — 0 (Zero)

The first use of 0 is widely debated. There is evidence in the Bakhshali Manuscript as well as in Maya and Babylonian mathematics. However, it was widely used as both a placeholder (for example in 50) and as a number itself (as in 4 – 4 = 0) by AD 650. Both were huge steps in mathematics. Using place value with a placeholder for empty columns allows us to quickly evaluate complex calculations.

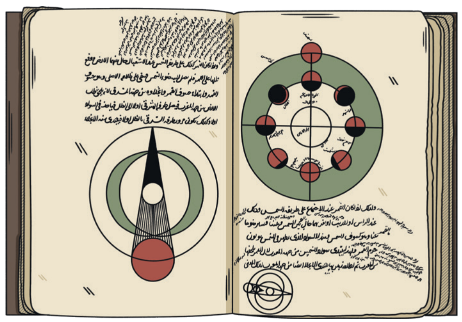


c. 830 — Muhammad ibn Musa al-Khwarizmi

Al-Khwarizmi was a Persian mathematician who spent most of his life in Baghdad. His book, usually called **Algebra**, explored how to solve problems which involved an unknown value. The method he used to solve them was called al-jabr; this method was the beginning of a whole new field of mathematics: algebra. As well as this gift, translations of his book also introduced decimals to Europe.

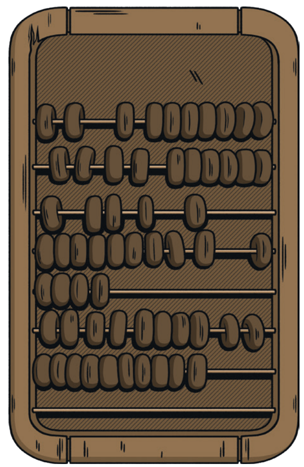
c. 953 — Kitab al-Fusul fi al-Hisab al-Hindi

This book, written by the Arab mathematician Abu'l-Hasan al-Uqlidisi, is the earliest surviving book that demonstrates the positional use of Arabic numerals in the way we use them today. The book is a formalisation of a system that describes how to use numerals to add, subtract and multiply, among other operations. While this was widely used by Indian mathematicians, this would have been revolutionary to many people.



c. 1200 — The Abacus

An abacus has beads on wires that can be used to quickly calculate additions and subtractions. An experienced user can also use it to multiply, divide and find square roots. In the form we know it today, it was first used in China and was called the soroban. While generally considered a precursor to the computer and pocket calculator, it is often used in parts of Asia and Africa.

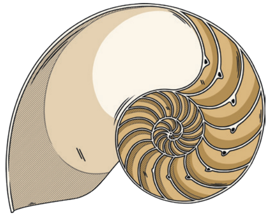


1202 Fibonacci's Liber Abaci

This book, written by Leonardo Fibonacci, introduced Hindu-Arabic numerals (the ones we use today) to Europe. It shows how to convert to Hindu-Arabic numbers from different number systems. It also introduced Western Europe to Fibonacci's famous sequence in which the next value is calculated by adding the previous two values: 1, 1, 2, 3, 5, 8, 13.

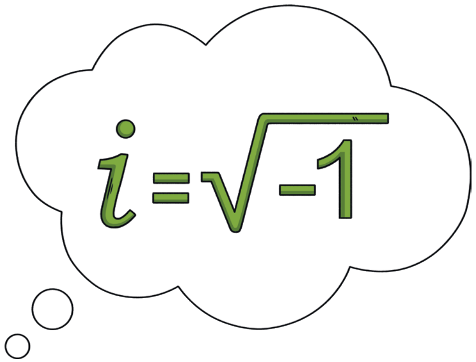
1509 The Golden Ratio

Humans have been aware of the golden ratio for thousands of years but in 1509 Luca Pacioli published a book, De Divina Proportione, about it. This ratio, denoted by the Greek letter phi (ϕ) is incredibly common in both mathematics and nature! The easiest way to envisage it is by considering a rectangle that has side lengths in the ratio a:b. If we cut this rectangle into a square and a smaller rectangle, the smaller rectangle will still have the same ratio a:b. This value, $\frac{b}{a}$, is equal to ϕ. The rectangle described is called the golden rectangle. If this process is repeated and a curve is drawn through the corner of each square, the resulting spiral is called the golden spiral.



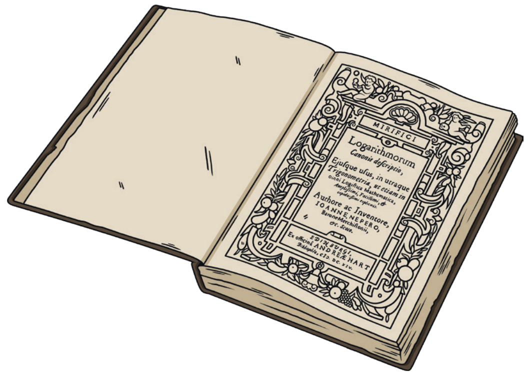
1572 Imaginary Numbers

An imaginary number is one that, when multiplied by itself, gives a negative answer. For example, $i = \sqrt{-1}$ and $i^2 = -1$. When this was first conceptualised, many mathematicians didn't believe they existed. In fact, the name *imaginary* was used by Descartes as an insult. However, the use of these numbers introduces vast fields to maths, physics and engineering, from fractal art to string theory.



1614 Logarithms

In 1614, John Napier discussed logarithms in his aptly named book, *A Description of the Marvelous Rule of Logarithms*. The logarithm (to base a) of a number x is written as $\log_a x$. This is equal to the power y that satisfies $a^y = x$.
For example, $2^5 = 32$ so $\log_2 32 = 5$. Before calculators, logarithmic tables were often used to help calculate complex multiplications.



1637 Fermat's Last Theorem

Pierre de Fermat was a French mathematician that contributed to many fields of maths. He is best known for Fermat's Last Theorem which he wrote in the margin of a textbook, stating that he had proved it but it wouldn't fit in the margin. However, he never wrote down the proof and it went unproven until 1994 when Andrew Wiles successfully proved the theorem. Fermat's Last Theorem states that, for any value of $n > 2$, there are no positive integers that satisfy $a^n + b^n = c^n$.

BEYOND

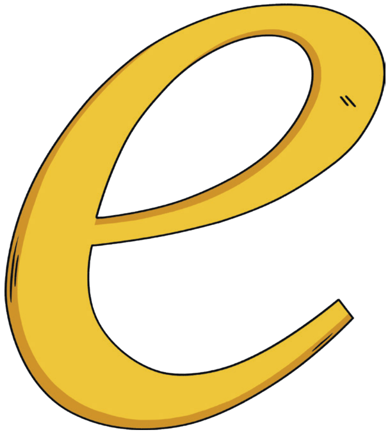
1665 Calculus

In the 1600s, two mathematicians had a large feud over how to split the credit for a new discovery: calculus. Gottfried Leibniz first published his discovery of calculus in 1684. Isaac Newton started work on calculus in 1665 but was slow to publish. Their debate slowed down the advancement of calculus significantly. Now, calculus plays an invaluable role in physics, chemistry, statistics, mechanics, economics and engineering (to name just few).

BEYOND

1727 Euler's Number

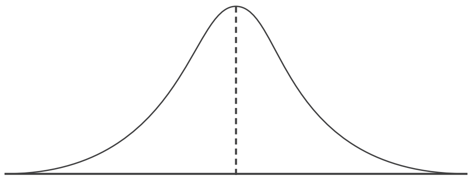
Although many mathematicians, including Bernoulli, were aware of this constant, Swiss mathematician Leonhard Euler was one of the first to study it in depth. He showed it was irrational (it can't be written as a fraction), calculated its value to 17 decimal places and chose the letter e to denote it. Now, modern computers can calculate its value and over 31 trillion digits are known. However, Euler knew it as $e = 2.7182818284590452$.



BEYOND

1733 The Normal Distribution

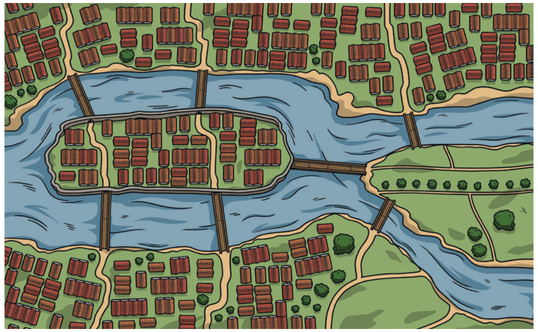
The normal distribution was first described by French mathematician Abraham de Moivre in 1733. It represents an important probability distribution where most events will happen around a centre point, the mean, and as you move away from this point, the probability of the event occurring decreases. This is used to model in countless fields including statistics, intelligence, genetics, astronomy and population demographics.



BEYOND

1736 Königsberg Bridges

One of the widest known problems of the 18th century involved the seven bridges of Königsberg, now in Russia. The challenge was to walk across each bridge in the town exactly once and return to the starting point. In 1736, Leonhard Euler proved that such a journey was impossible and, consequently, founded the area of maths known as graph theory.



BEYOND

c. 1761 Bayes' Theorem

Bayes' theorem is a formula used in probability; specifically, conditional probability. Conditional probability is the chance of something happening given that something else has happened. For example, P(A|B) is the probability of A happening given B has happened. This could be the probability of it raining given it is cloudy. At some point in his life, British mathematician and Presbyterian minister Thomas Bayes showed that this can be found using $P(A|B) = \frac{P(B|A)P(A)}{P(B)}$.

BEYOND

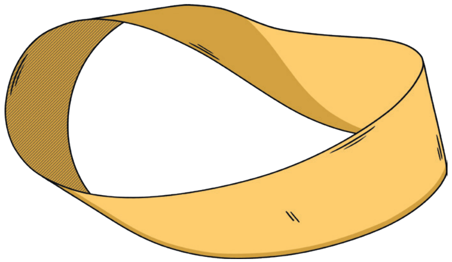
1797 The Fundamental Theorem of Algebra

The Fundamental Theorem of Algebra is stated in many different ways. It states that a polynomial $P(x)$ of degree n has exactly n solutions to $P(x) = 0$, although some of these solutions may be repeated or complex (imaginary). There were many attempts to prove it throughout history but the first proof is credited to Carl Gauss in 1797.

BEYOND

1858 The Möbius Strip

German mathematician August Ferdinand Möbius made his most famous discovery, the Möbius strip, at almost 70. To make a Möbius strip, take a bookmark and turn one end 180° then join the two ends together. The result is a 2-dimensional shape that can only exist in 3-dimensions. In other words, you can't colour one side red and the other blue because there is only one side. The Möbius strip was the first one-sided surface discovered by humans!



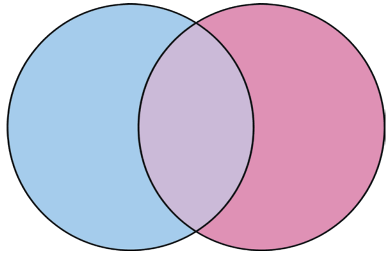
BEYOND

1874 The Doctorate of Sofya Kovalevskaya

The Russian mathematician, Sofya Kovalevskaya was the first woman in history to receive a doctorate in mathematics. In 1874, Kovalevskaya received her doctorate for her work on partial differential equations, Abelian integrals and the structure of the rings of Saturn. Despite this doctorate, Kovalevskaya was unable to obtain an academic position for years because of her gender.

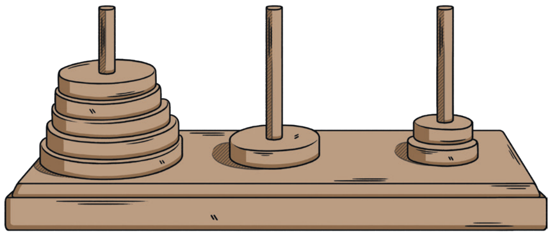
1880 Venn Diagrams

John Venn was a British philosopher and church cleric. He developed a way to represent data and sets that share certain relationships. While other people had used similar diagrams, John Venn studied them and formalised the uses of them and, therefore, they are named after him – Venn diagrams. He spent a lot of time attempting to draw symmetrical diagrams to visualise more sets with multiple intersecting areas.



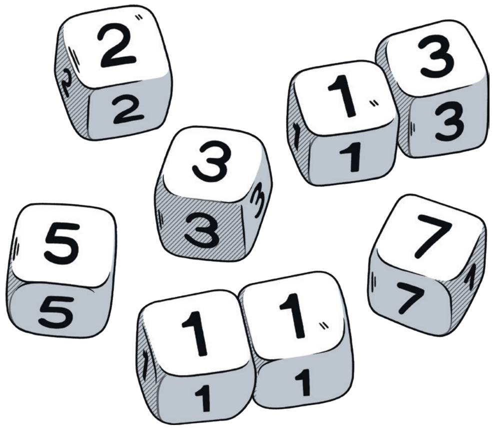
1883 The Tower of Hanoi

This problem has intrigued millions since it was invented by French mathematician Édouard Lucas in 1883. The puzzle has several discs and three pegs. To start with, the discs are all on one peg in order of size with the largest on the bottom. The goal is to remove the entire stack to another peg without ever placing a disc on top of a smaller one.



1896 Proof of the Prime Number Theorem

The Prime Number Theorem was first proposed by Carl Fredrich Gauss. He proposed that the number of primes less than or equal to n, denoted by $\pi(n)$, is roughly equal to $\frac{n}{\ln n}$, although he later amended this to $\int_2^n \frac{1}{\ln x} dx$. In 1896, French mathematician Jacques Haramard and Belgian mathematician Charles-Jean de la Vallée-Poussin proved the theorem independently.



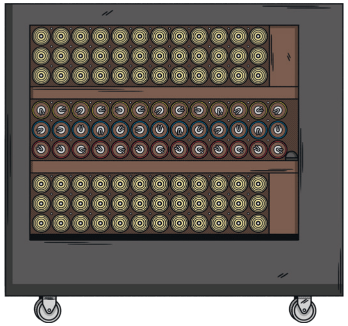
1913 The Infinite Monkey Theorem

The infinite monkey theorem states that a monkey sat at a typewriter for an infinite amount of time will eventually type a particular text such as Shakespeare's full work. Consider the quote "a rose by any other name". This phrase contains 24 characters (including spaces) and there are 84 keys on a typewriter. So, the probability of the monkey randomly hitting 24 consecutively correct characters is $\left(\frac{1}{84}\right)^{24}$ which is roughly 6.6×10^{-47}! However, with an infinite amount of time, the monkey would eventually get it right!

BEYOND

1940 The Turing Machine

Alan Turing was an English mathematician and computer theorist known as the father of computer science. During the Second World War, Turing worked with a team to break the Enigma code used by the Nazis. Turing's machine, called the Bombe, became the main tool for deciphering Enigma communication. As the work was highly classified, Alan Turing was not recognised as having contributed to the war effort. In 1952, Turing was prosecuted for homosexual acts; the law has since changed and Turing's punishment is completely unethical by today's standards.



BEYOND

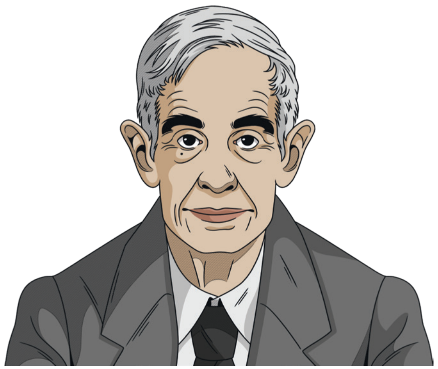
1946 ENAIC

The ENAIC, short for Electronic Numerical Integrator and Computer, was built at the University of Pennsylvania. It was the first electronic, reprogrammable computer that could be used to solve a large range of problems. It was in continuous use from its unveiling in 1946 until it was turned off in October 1955. The machine contained more than 17 000 vacuum tubes and around 5 million hand-soldered joints.

BEYOND

1950 The Nash Equilibrium

In game theory, the Nash equilibrium describes a game between two or more players in which every player has chosen a strategy and no player has anything to gain by changing their strategy if the other player's strategy stays the same. This equilibrium has been applied to not only game theory but international politics, war and economics.



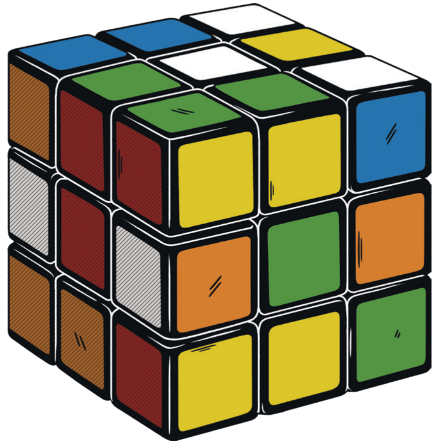
BEYOND

1972 The First Scientific Pocket Calculator

In 1972, Hewlett-Packard (HP) developed the world's first pocket calculator called the HP-35 (because it had 35 keys). The company developed this calculator despite market research predicting it to fail. In the first year, they sold 100 000. Today, scientific calculators are cheap and there is an app on most mobile phones. This has completely changed how mathematics is studied and taught worldwide.

1974 The Rubik's Cube

Hungarian inventor Ernö Rubik invented the Rubik's cube in 1974 and patented it in 1975. Within 5 years, as many as 10 million cubes had been sold in Hungary alone – more than one per person! The challenge is to rotate the smaller cubes so that every face of the cube is a solid colour. There are over 43 quintillion different arrangements of the small cubes – only one of which is the final solution.



1977 RSA Public Key Cryptography

A paper published in 1977 by Ron Rivest, Adi Shamir and Leonard Adleman changed the face of cryptography by creating a working, asymmetric, public-key cryptosystem. RSA relies on the fact that it is very hard to find the factors of large numbers, especially of those known as semi-primes (the product of two prime numbers). As the numbers become larger, the time taken to factor the numbers increases massively and this provides the security in encoding a message using the RSA cryptosystem.