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PARAM

SCIENCE MAGAZINE

Why π ?

Love for Maths
vs Life's Odds

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The Mythic Society

Message from the Editorial Desk

This month, Param Science Magazine joins the global chorus in celebrating π Day! π isn't just a number – it's a story that weaves through the fabric of the universe, guiding rockets into space with the precision of an atom and whispering the secrets of circular harmony in nature.

Math, the queen of sciences, is our most indispensable tool. It's hard to imagine where humanity would stand without it – probably still dreaming of the stars without the calculus to reach them, or understanding the cosmos without π to decode its patterns. From the simplicity of numbers in nature to the legendary mystery of values we chase, math is the heartbeat of scientific evolution.

But math isn't just equations and cold logic. It's a human endeavour fueled by passion and perseverance. This issue also shines a light on the mathematicians whose lives were as complex as the problems they solved. Their stories remind us that behind every great discovery is a person with a dream, a relentless pursuit of understanding. Many of these heroes faced personal struggles and hardships, yet their unwavering passion for numbers continues to shape our world today.

So, grab a slice of pie (a delicious homage to π, of course!), and marvel at the magic of mathematics and its role in our quest to unlock the universe. Here's to the numbers that shape our world and to the people who uncover their secrets.

Saurab Gupta
Managing Editor

We are keen to hear your thoughts. Connect with us at magazine@paraminnovation.org and join the conversation.

ON THE COVER
An AI visualisation of π
as the supreme number

All the references for this magazine can be found on **paraminnovation.org/magazine-references/**

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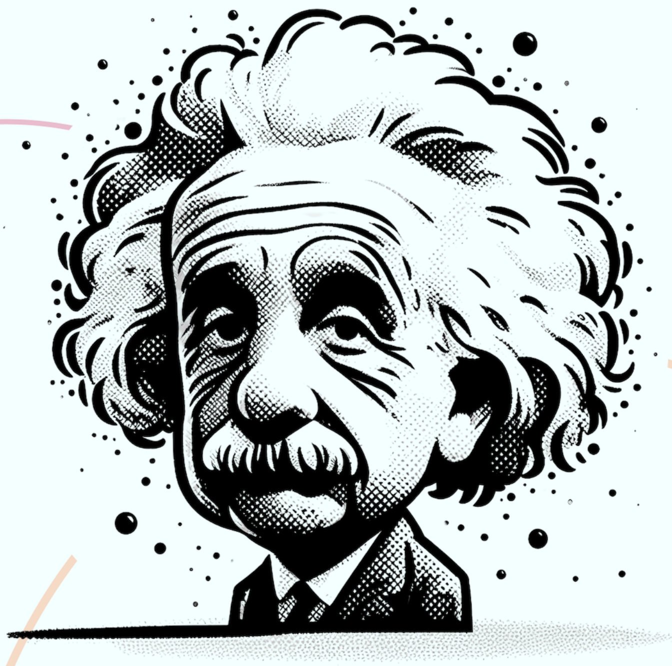
WHY π?

π—have you heard about it? Not the dessert pie, but π, the celebrated number in mathematics. This constant, derived from the simple shape of a circle, has intrigued scholars, mathematicians, and the curious for over 4,000 years. With π Day around the corner, let's dive into everything about π and uncover why this number has captured our fascination for millennia.

Why is Pi Day Celebrated?

The world celebrates Pi Day, on the 14th of March every year, as a tribute not just to the enigmatic number π but also to the legendary Albert Einstein. This quirky holiday sprang to life in 1988, thanks to the imaginative staff, Larry Shaw, at the Exploratorium. What began as a spirited attempt to foster connection among the museum staff quickly evolved into an annual spectacle, weaving in a celebration of Einstein's genius.

As the years rolled on, π Day transcended its humble origins, blossoming into an international phenomenon recognized by math aficionados and pie lovers alike. In 2009, this celebration of circular reasoning and sweet treats was officially etched into the U.S. national calendar, a testament to the universal appeal of π.



What is π?

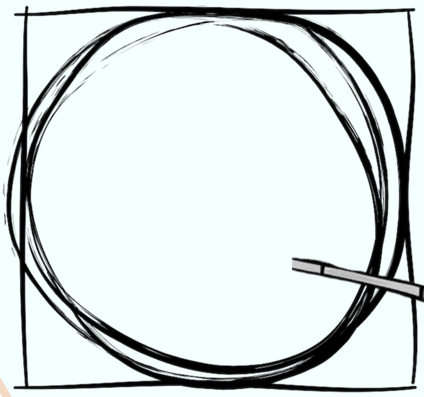
π (Pi) is the ratio of a circle's circumference to its diameter, instrumental in computing the area of a circle, the volume of a sphere, or the surface area of a cone. Unlike rational numbers, π is irrational, meaning it cannot be precisely expressed as the ratio of two integers. Common approximations like 22/7 and 355/113 offer a glimpse into π's value, but they fall short of capturing its true essence. Owing to its irrational nature, π features an infinite series of non-repeating digits in its decimal expansion.

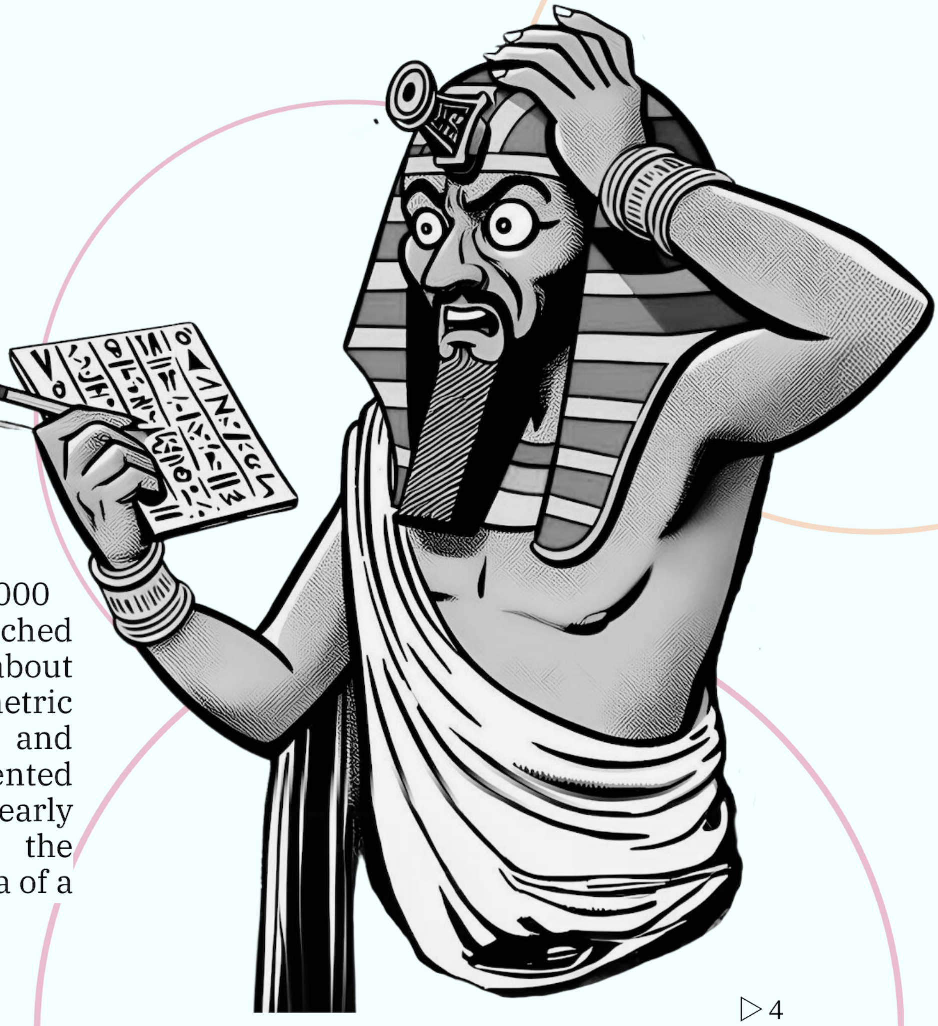
$$\pi = \frac{\text{circumference}}{\text{diameter}}$$

Origins

The journey of π began with simple observations – measuring a circle's circumference compared to its diameter reveals π as a constant ratio, regardless of the circle's size. This discovery laid the groundwork for millennia of mathematical exploration, from the Greeks and Babylonians to the Egyptians.

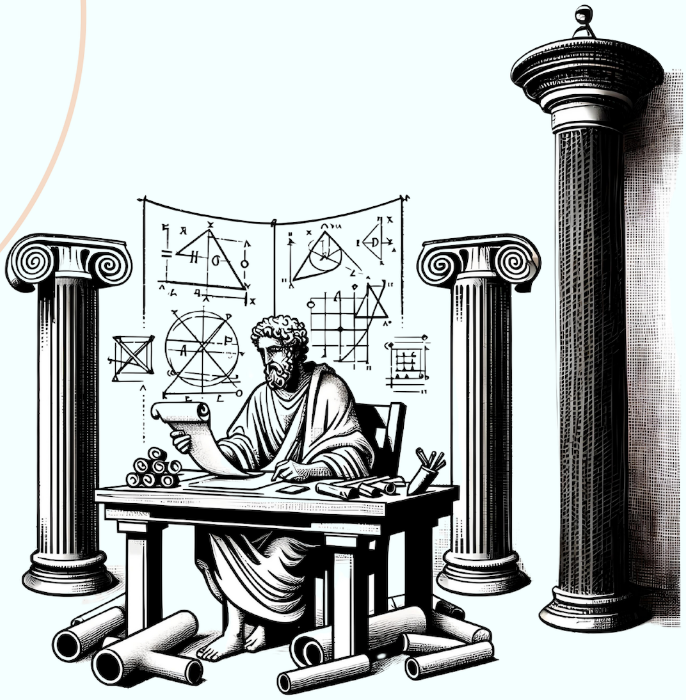
The Babylonian Method: The Babylonians estimated π to be about 3.125, a calculation based on the ratio of a hexagon's perimeter inscribed in a circle, showcasing an early mathematical endeavour to understand circular geometry.

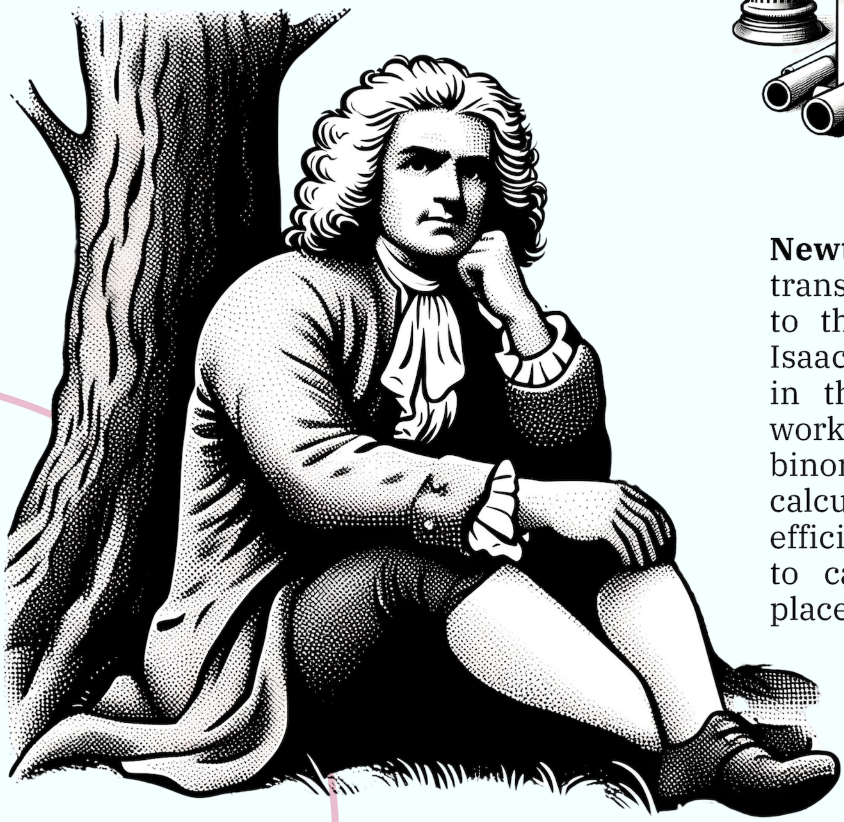




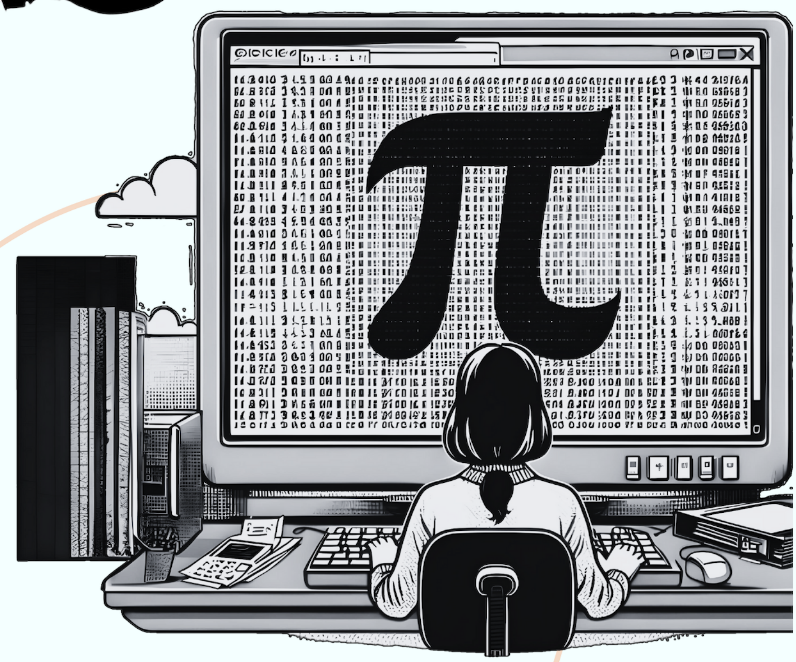
The Egyptian Method: Nearly 4000 years ago, the Egyptians approached π with an approximation of about 3.160, derived from geometric assumptions about circles and squares. This method, documented in the Rhind Papyrus, reflects early human attempts to grasp the concept of π by equating the area of a square to that of a circle.

The Archimedean Method: Archimedes of Syracuse significantly advanced the calculation of π. By examining the perimeters of polygons inscribed in and circumscribed around a circle, he established π to be between 3.1408 and 3.14285. This was achieved by employing polygons with up to 96 sides to refine his approximation.

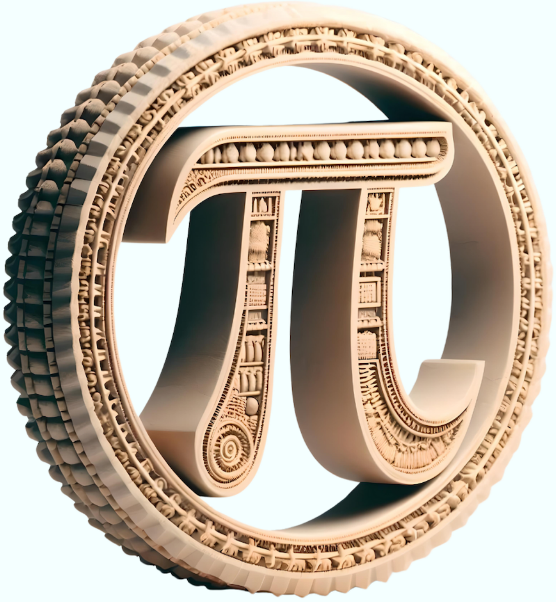




Newton’s Approximation: The transition from geometric methods to the calculus innovations of Sir Isaac Newton marked a πvotal shift in the calculation of π. Newton's work on infinite series and the binomial theorem enabled the calculation of π with unmatched efficiency and precision. He was able to calculate π up to 15 decimal places.



Modern Approaches: Introduced by William Jones in 1706 and later popularized by Leonhard Euler, the symbol π has become iconic. The modern understanding and calculation of π have evolved significantly, with sophisticated algorithms and powerful computers calculating π to trillions of digits, highlighting the relentless quest to fully comprehend this mathematical constant.



ancient in indian maths

In the Shulba Sutras

The construction of fire altars, central to Vedic rituals, necessitated a profound understanding of geometric principles. The Shulba Sutras, ancient Indian texts, provide the earliest references to π, showcasing an understanding that the ratio of a circle's circumference to its diameter is a constant. This realization was pivotal for constructing precise circular altars, which necessitated an approximation of π. While reaching an accuracy beyond 3.1416 seemed distant, their efforts marked a significant leap towards recognizing π's universality.

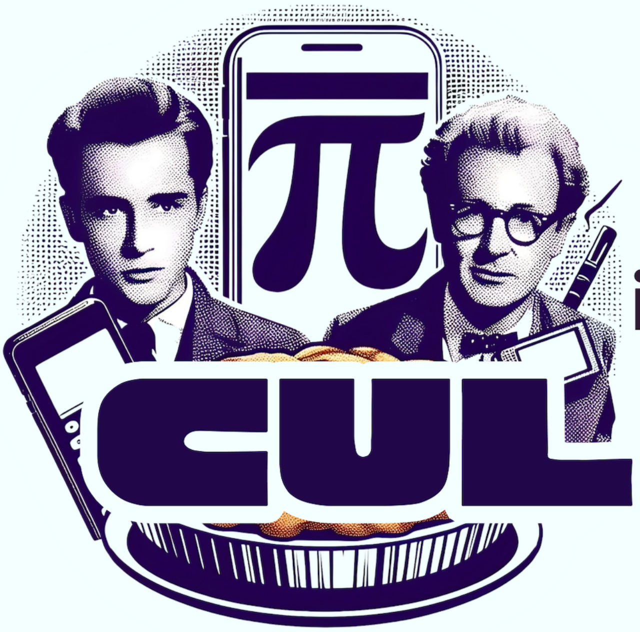
Aryabhata's Formula

The legendary mathematician Aryabhata, revered for introducing the decimal system, ventured beyond conventional boundaries to elucidate π's principles. His remarkable formula — adding four to 100, multiplying by eight, and then adding 62,000—offers a method to calculate a circle's circumference given its diameter. Aryabhata's contributions, encapsulated in Sanskrit verses, underscore an era when Indian mathematicians were not merely solving puzzles but were *π*oneers in the truest sense, laying down the foundations for future explorations of π.

चतुराधिकं शतमष्टगुणं द्वाषष्टिस्तथा सहस्त्राणाम्।
अयुतद्वयस्य विष्कम्भस्य आसन्नौ वृत्तपरिणाहः ॥

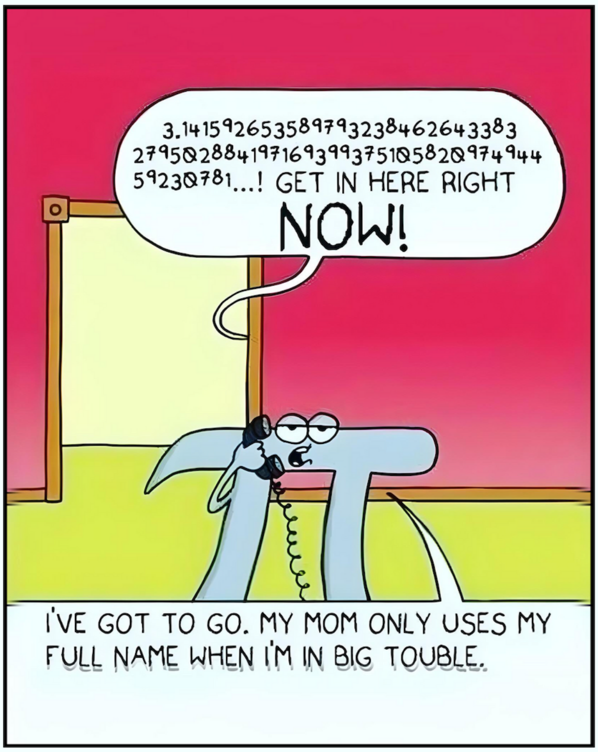
(Chaturadhikam śatamaśṭaguṇam dvāśaśṭistathā sahasrāṇām
Ayutadvayaviśkambhasyāsanno vrîttapariṇahaḥ)

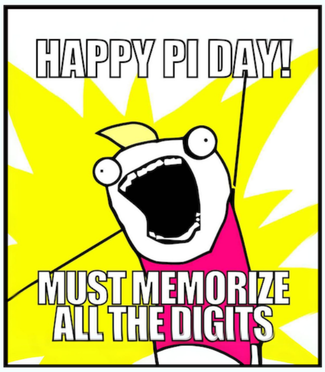
"Add 4 to 100, multiply it by 8 and then add 62,000; this is approximately the circumference of a circle of diameter 20,000."

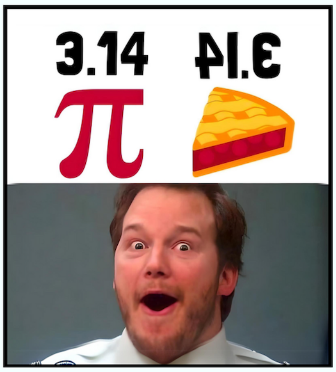


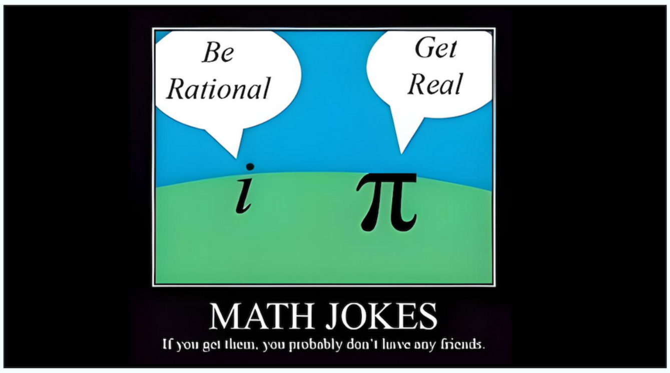
in POP CULTURE

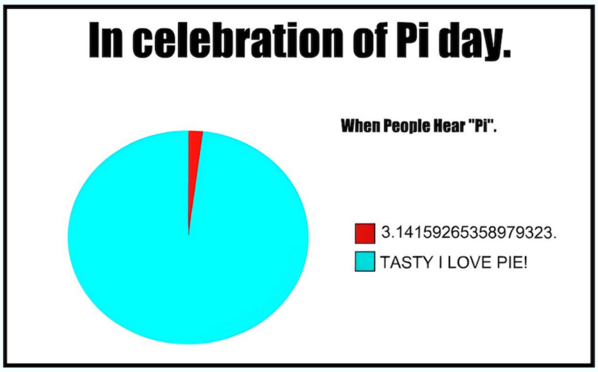
π's influence reaches into pop culture, celebrated in songs, movies, and memes. π Day brings enthusiasts together to revel in π-related festivities, from pie-eating contests to discussions on the number's endless mysteries

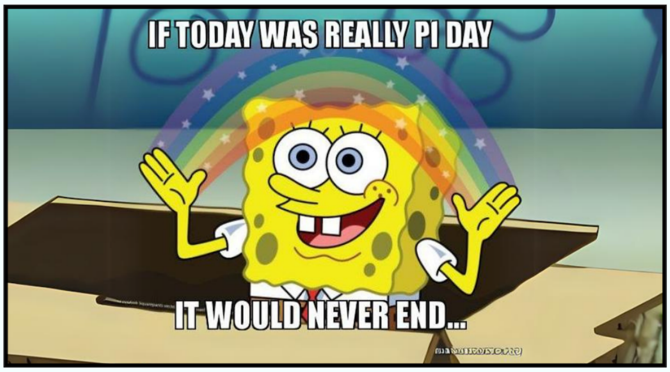




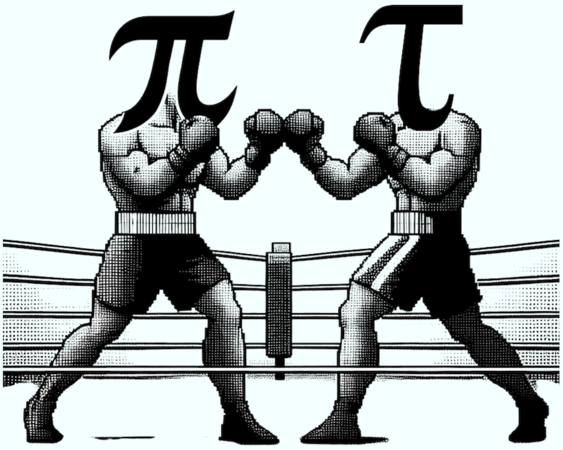




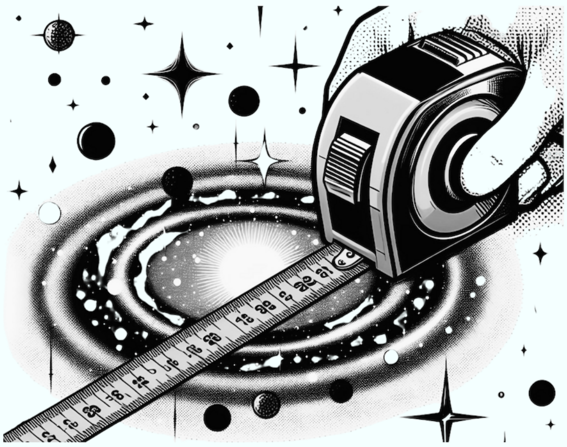




RANDOM FACTS



Before the 18th century, people referred to π as “the quantity which when the diameter is multiplied by it, yields the circumference.” It's no surprise that this lengthy description was eventually set aside for something more succinct. The transformation came thanks to William Jones, a Welsh mathematician and friend of Sir Isaac Newton, who first used the symbol π in 1706,



Since π is an irrational number, it means its decimal expansion goes on forever without repeating. Theoretically, this suggests that any finite sequence of numbers, including your phone number, exists somewhere within π's endless digits.

π has a counterpart in τ (Tau), a constant that, unlike π, represents the ratio of a circle's circumference to its radius. Advocates of Tau argue that it offers a more intuitive approach to circular mathematics. According to them, using τ simplifies concepts, enhances clarity in teaching, and better aligns with the natural units and symmetries found in mathematics and the physical world.

You only need 38 digits of π, including the initial 3, for precision down to a hydrogen atom's size because this level of detail exceeds nearly all universal measurement needs. These digits enable calculations for enormous distances, like circumferences of circles spanning billions of light years, with accuracy far beyond the microscopic scale of an atom.

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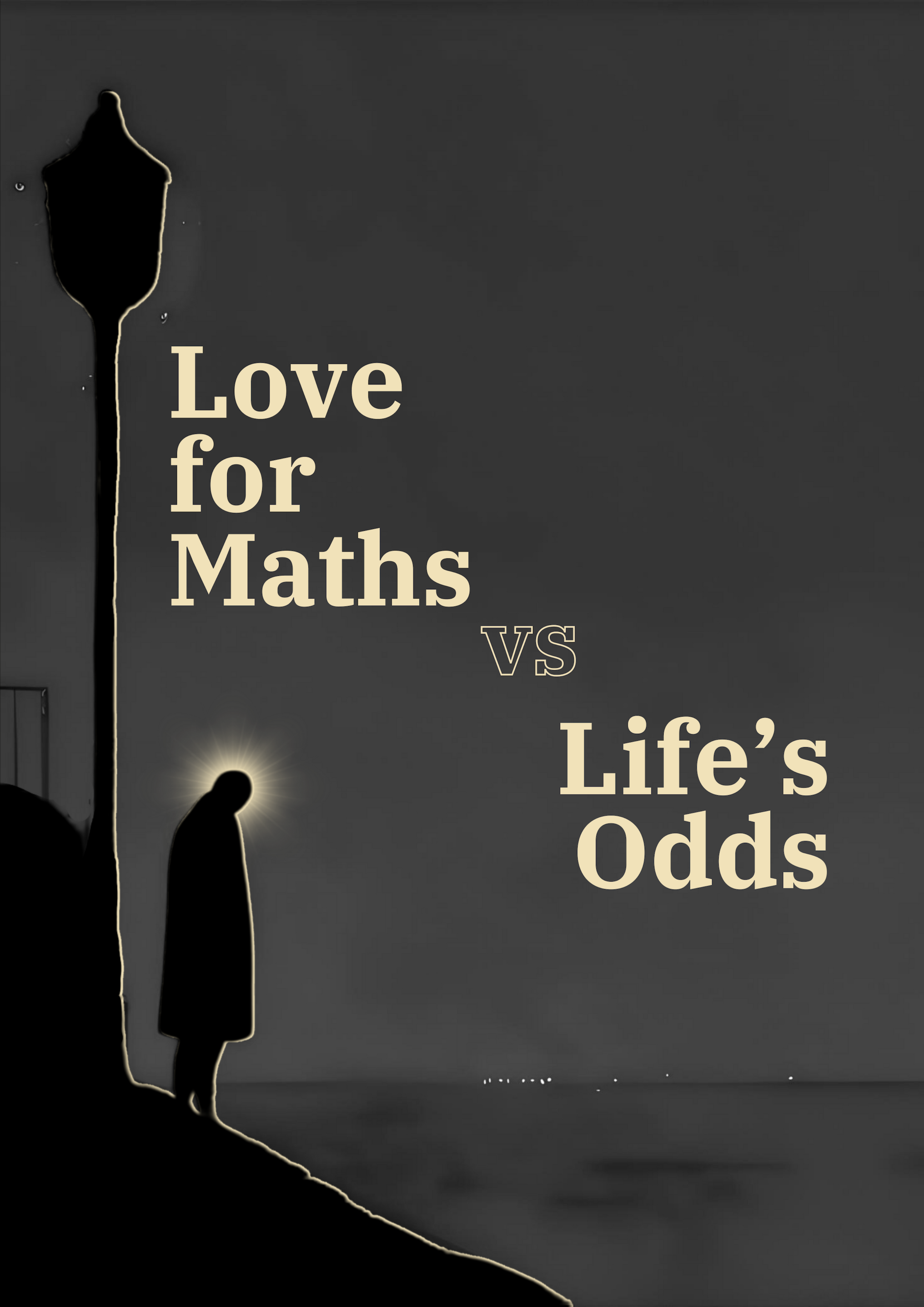
Love
for
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Odds

Will you ever take up struggles to elevate mathematics and make the world a better place?

Well, our mathematical geniuses have done so, willingly embracing hardships without a single complaint, driven by their devotion to humanity and passion for mathematics.

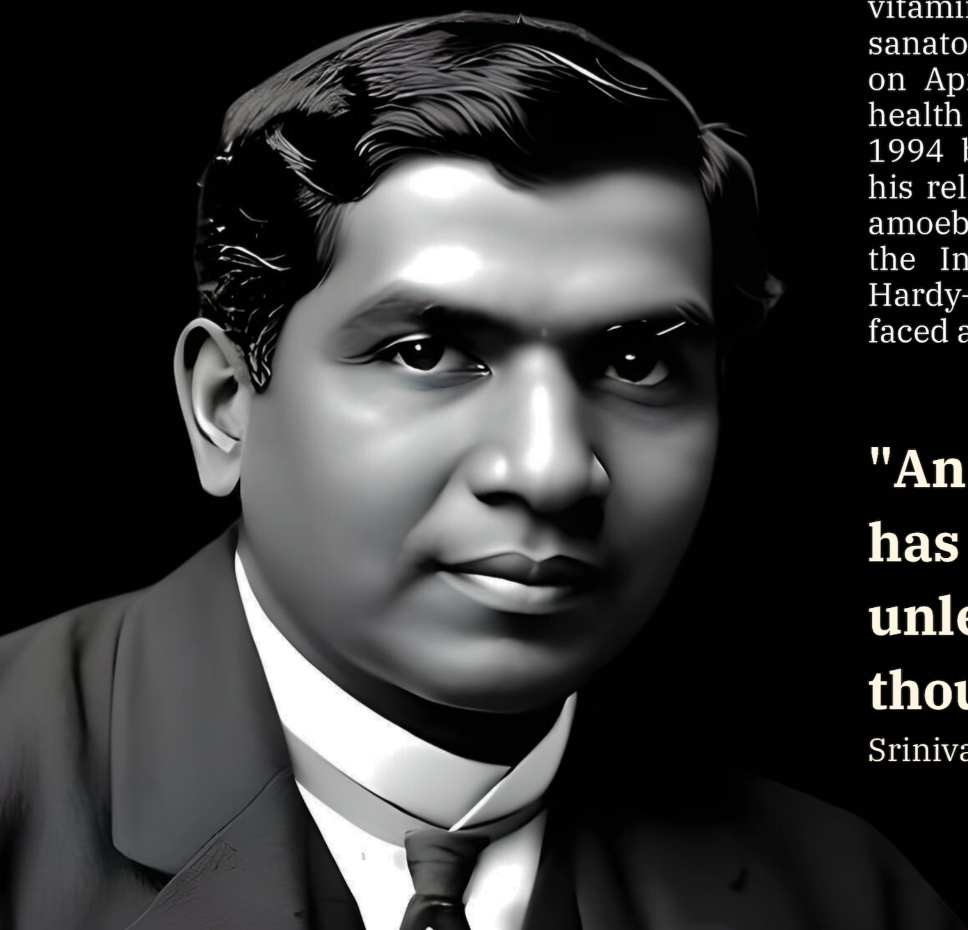
Mathematics innovation is often stratified as the domain of abstract thoughts and cold logic, masking explicit narratives of human drama. Elegant theorems and intricate formulas often mask the personal journeys of tragedy, isolation, and despair of mathematical legends. These legends, while celebrated for their groundbreaking contributions to mathematics, led lives filled with the agonyof mental strife, misunderstanding, and unfulfilled desires. The story of most mathematical geniuses is a blend of triumph and sorrow, offering us a sense of empathy for their struggles and perseverance.

Srinivasa Ramanujan

Did defining "zero" minimise the value of Ramanujan's lifespan? Although we are highly motivated to address the contributions of the philosophical mathematician from India, we are still assessing the tragedies he faced.

Ramanujan's contribution to the field involves mathematical analysis, number theory, infinite series, and continued fractions. Born on December 22, 1887, this mathematical maestro grew up in Kumbakonam, a small town in Tamil Nadu, facing financial and health issues for 32 years.

Ramanujan's genuineness towards mathematics has been evident from an early age. Although largely self-taught, his deep love for mathematics helped him formulate complex ideas that baffled the Indian mathematical society. His primary educational problem was that he knew only mathematics and performed poorly in other subjects like English, physiology, and Sanskrit.



The genius was not able to find any solution to his health problems throughout his life, which deteriorated even further when he was in Cambridge, England. It has resulted from his strict dietary requirements based on religious beliefs. War-time rationing from 1914 to 1918 impacted his harsh conditions. He was diagnosed with "hydrocele testis" but was not able to afford the operation because of his family's financial conditions. In England, he was diagnosed with tuberculosis and vitamin deficiency and confined to a sanatorium; after returning, he died on April 26, 1920. A study on the health conditions of Ramanujan in 1994 by D.A.B Young signifies that his relapses were caused by hepatic amoebiasis. The genius developing the Infinite series for Pi (π) and Hardy–Ramanujan number (1729) faced a catastrophic life till the end.

"An equation for me has no meaning unless it expresses a thought of God."

Srinivasa Ramanujan

Alan Turing

Can the taboo of "Homosexuality" pour into personal tragedy in a genius's life after the most significant contribution that changes the lives of others? Alan Turing has been one of a kind, having a life of remarkable brilliance in scientific achievements and tragedies of profound complexities. The person who laid the foundation for modern computing led a life of several social prejudices of his time.

It was in 1952 that Turing's personal life came to legal scrutiny with a break-in at his home, which led to the revelation of his homosexuality in Britain at that time. The options provided to Turing were either chemical castration or life imprisonment. Turing chose chemical castration, a decision that led to severe physical and emotional side effects, including emotional distress and physical changes. These emotional struggles culminated in Turing's tragic death in 1954, attributed to cyanide poisoning – a conclusion supported by the discovery of a half-eaten apple by his bedside.

Yet, these personal adversities did not overshadow Turing's intellectual legacy, including the development of the Universal Turing Machine. This invention marked the initiation of the digital age, demonstrating specific mathematical problems with algorithmic solutions. The father of computation has also received posthumous recognition, embodying the spirit of perseverance and innovation. The reflection on the cost of societal intolerance, resulting in loss of potential, is represented by Alan Turing. He also signifies as a beacon of hope to future generations about pursuing knowledge and understanding, amidst a transcendent personal tragic life.

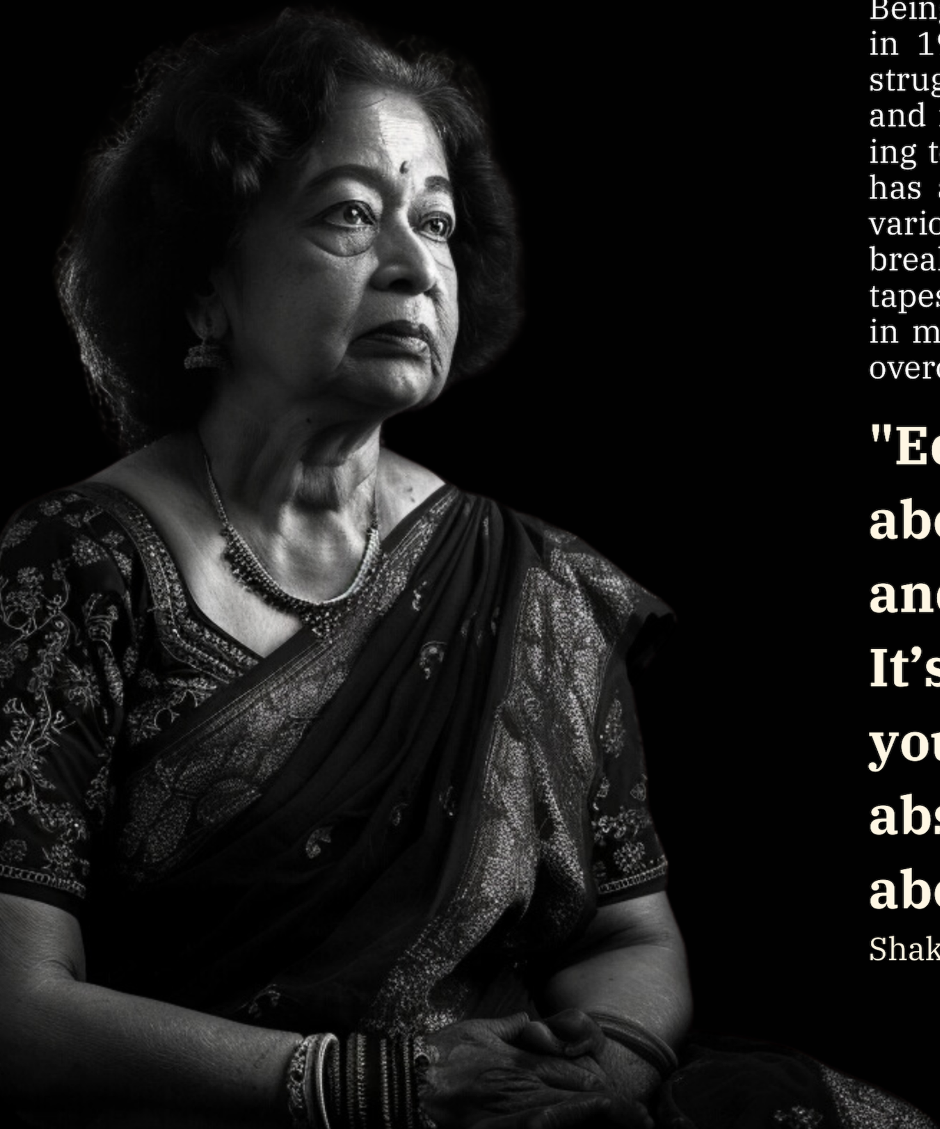
"A computer would deserve to be called intelligent if it could deceive a human into believing that it was human."

Alan Turing

Shakuntala Devi

Although celebrated as the “human computer” for her mathematical abilities, she witnessed a life full of adversities in her journey to public acclaim. She was born to a low-income family in Bangaluru with financial constraints, such as being unable to afford a school fee of Rs 2. Although deprived of formal education during childhood, her growing passion for mathematics propelled her towards the limelight.

Shakuntala Devi also faced gender inequality, compounded by societal and familial challenges.



Her marriage to an officer of the Indian Administrative Service was the dawn of her emotional and psychological battles in life. She was divorced in 1979, and there were controversies over her credibility & personal relationships. The dissolution of her marriage publicised her husband's alleged homosexuality & complex relationship with her daughter. Her stature as a public figure could not insulate the psychological and emotional toll of her complexities.

The maintenance of her global reputation estranged her from her daughter due to her itinerant lifestyle. Being a Guinness Book record holder in 1982, she faced multiple health struggles regarding kidney, heart and respiratory complications, leading to her demise in 2013. Her story has always been a reminder of the various challenges women face in breaking societal norms. Having a tapestry of enormous achievements in mathematics did not allow her to overcome life without hardships.

"Education is not just about going to school and getting a degree. It’s about widening your knowledge and absorbing the truth about life."

Shakuntala Devi

Sophie Germain

Some journeys to the mathematics core have been discriminated against due to gender biases in the 18th century. Although she was born into a wealthy upper-class family in France, her love for mathematics was barred by gender discrimination. She was born in 1776 and experienced women's intellectual pursuits being discouraged and actively suppressed. Despite this, Germain's fascination with mathematics faced significant opposition from her family. The extent of cruelty towards Sophie Germain was that she had been deprived of warm clothes by her parents to deter her passion for mathematics. The persistence of her determination allowed her to wrap up in quilts and study under candlelight after her parents had slept.

The societal barriers for Sophie Germain to practise mathematics extended beyond her home with significant institutions not allowing mathematical advancements by women. The then assumed fault of being a woman devoted to mathematics barred her from formal education in the subject.

To counter the circumstances, Sophie Germain had to adopt the name of a male student, Antoine-Auguste Le Blanc. The societal pressures of ridicule and dismissal underscored her profound isolation and challenges as a pioneer for women in science.

Despite the adversities, Sophie Germain became the first mathematician to formulate a cohesive plan for proving Fermat's Last Theorem. Her final years, marked by a battle with breast cancer, epitomise the hardships she faced in life. She continued with her dedication to maths amidst the unbearable pain. In its true sense, she died in 1831 as an annuitant rather than a mathematician.

"Algebra is but written geometry, and geometry is but figured algebra."

Sophie Germain

Évariste Galois

A combination of unparalleled intellectual achievements and tragic circumstances encircle the life of Évariste Galois. Galois was one of the genuine republicans during the French Revolution of the 1830s. The central issue of his troubled life was that he got arrested multiple times and was imprisoned due to numerous clashes between his revolutionary works in mathematics & the then political scenario. A combination of the political landscape of the time conflicting with his unwavering dedication to mathematics has been the root cause of his demise.

The mathematical genius's demise was not a regular event and is, to date, considered mysterious.

A sudden duel happened on May 30, 1832, and amidst a trigger-pulling scenario, Galois's gun was unloaded. The cause of this duel remains unclear even now, with speculations ranging from romantic rivalry to irreconcilable political conditions. However, the outcome has resulted in Galois's life ending just at the age of 20. His death has been a testament to the intersections of passion, politics and personal vendetta

His contribution to mathematics lasted until his duel. He wrote letters about groundbreaking mathematics, which included seminal works on the solvability of polynomial theorems using radicals. The tragic genius's dedication and contribution led to the founding of the “Galois Theory”. The full potential of his work was only revealed after his demise through the publication of his works by Joseph Liouville in 1846.

"[Mathematics] is the work of the human mind, which is destined rather study than to know, to seek the truth rather than to find it."

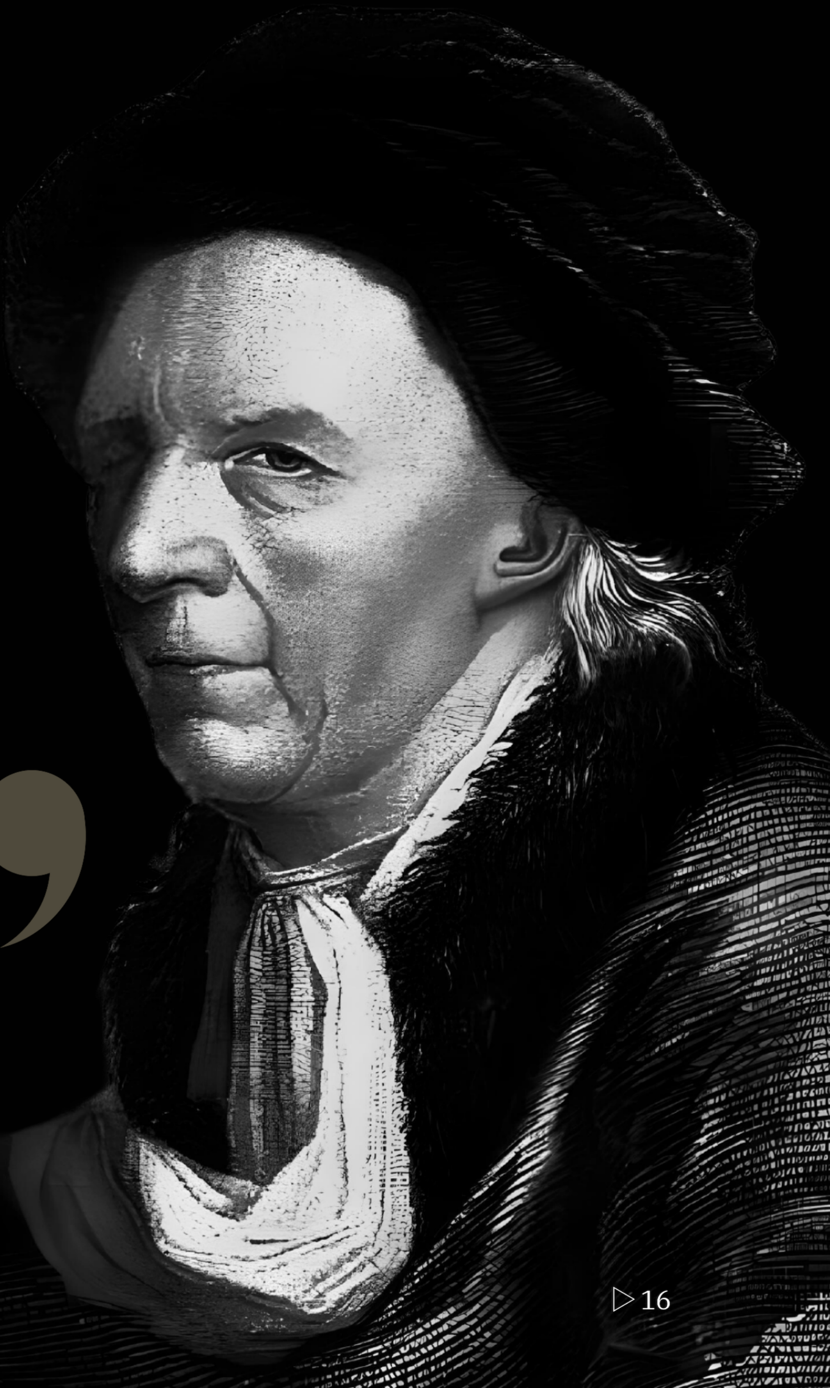
Évariste Galois

Leonhard Euler

This mathematical maestro believed that logic is the foundation of “all” acquired knowledge. Tragic stories about Euler are primarily about his health, specifically his eyesight. This titan of mathematics was renowned for his intellectual contributions. Euler's arrival at the Saint Petersburg Academy marked an era of scientific enlightenment, bridging scientific gaps between Russia and Western Europe.

The death of Catherine I and the ascension of Peter II initiated a profound impact on the academic fortune. The suspicion and conservatism of the Russian nobility imposed reduced funding and increased isolation of Euler and his fellow followers. In 1738, Euler lost his right eye, a setback that impacted his cartographic work and introduced multiple challenges. Despite this profound disability, Euler did not lose hope and increased his output of genius work.

September 18, 1783, marked the end of an era in mathematics shaped by Euler, who introduced the concepts of functions and mathematical notations to number theory, analysis and beyond. His life has been a testament to the indomitable spirit of human curiosity to contribute infinitely to the tapestry of human knowledge.



"Nothing takes place in the world whose meaning is not that of some maximum or minimum."

Leonhard Euler

Science Updates

Green Retreats in Concrete Jungles Boost Teen Mental Health

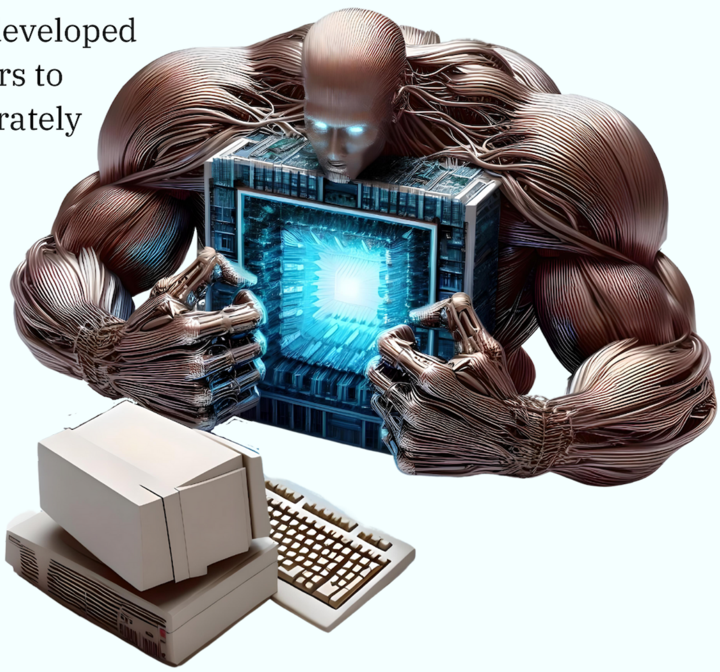
A University of Waterloo study finds that incorporating nature into city design, like forest bathing in urban settings, significantly improves adolescent mental health. Observing nature quietly and breathing deeply in green spaces reduces anxiety and enhances well-being, providing essential data for urban planning focused on health.

From Formaldehyde to Life

Scientists propose that organic molecules on Mars may stem from atmospheric formaldehyde. This breakthrough, achieved through sophisticated modelling, reveals ancient Mars could foster biomolecules essential for life, reshaping our search for extraterrestrial existence.

Quantum Leap? Think Again

Researchers at New York University have developed an algorithm that allows classical computers to perform calculations faster and more accurately than quantum computers, challenging the anticipated dominance of quantum computing. This research suggests that optimising classical computing could significantly advance computational capabilities.



Why are blueberries blue? (Hint: It’s not the pigments)

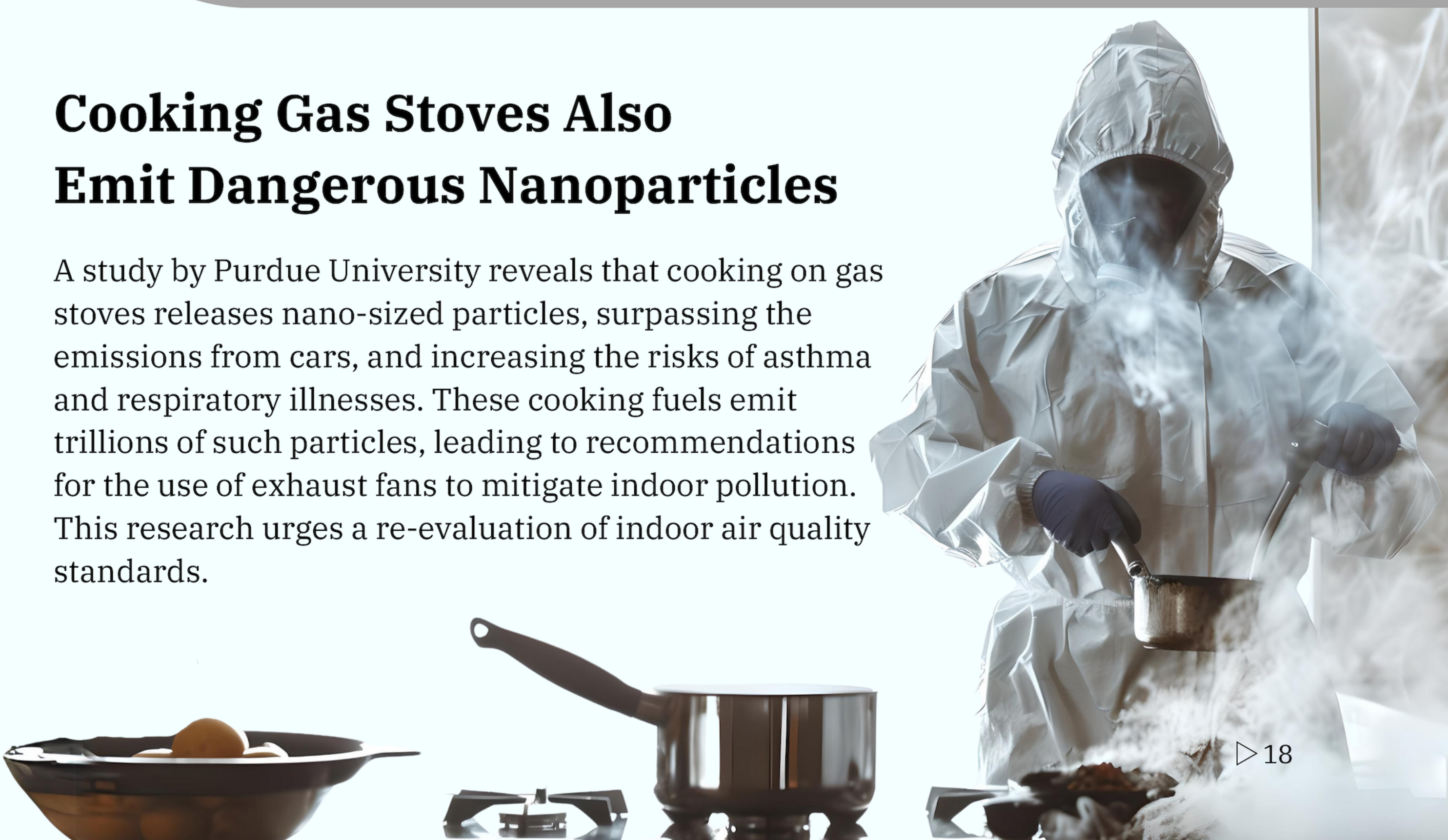
Researchers at the University of Bristol unveil the true cause of blueberries' blue colour—tiny structural elements within the fruit's wax coating manipulate light to create their vibrant hue, paving the way for innovative natural colourant technologies.

Favoritism Fuels Learning

Research from Lund University uncovers that our brains are wired to learn better from individuals we favour. This preference significantly influences memory and social interactions, highli--ghting the profound impact of personal likes on knowledge acquisition and attitudes. The findings have significant implications for understanding social dynamics and educational approaches.

Cooking Gas Stoves Also Emit Dangerous Nanoparticles

A study by Purdue University reveals that cooking on gas stoves releases nano-sized particles, surpassing the emissions from cars, and increasing the risks of asthma and respiratory illnesses. These cooking fuels emit trillions of such particles, leading to recommendations for the use of exhaust fans to mitigate indoor pollution. This research urges a re-evaluation of indoor air quality standards.



Support Us

Philanthropy can transform visions into realities, as shown in the story of Dr. Leroy Hood. His idea for an automated DNA sequencer, initially met with skepticism, was brought to life through the visionary support of philanthropist Sol Price. This breakthrough paved the way for the human genome project, illustrating how strategic donations can lead to monumental scientific achievements.

In this spirit, Param Science Magazine invites you to be part of a similar transformative journey. Your contributions are integral to our mission of making science accessible, engaging, and inspiring. By supporting Param, you do more than just fund a magazine, you nurture a culture brimming with innovation and discovery.

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