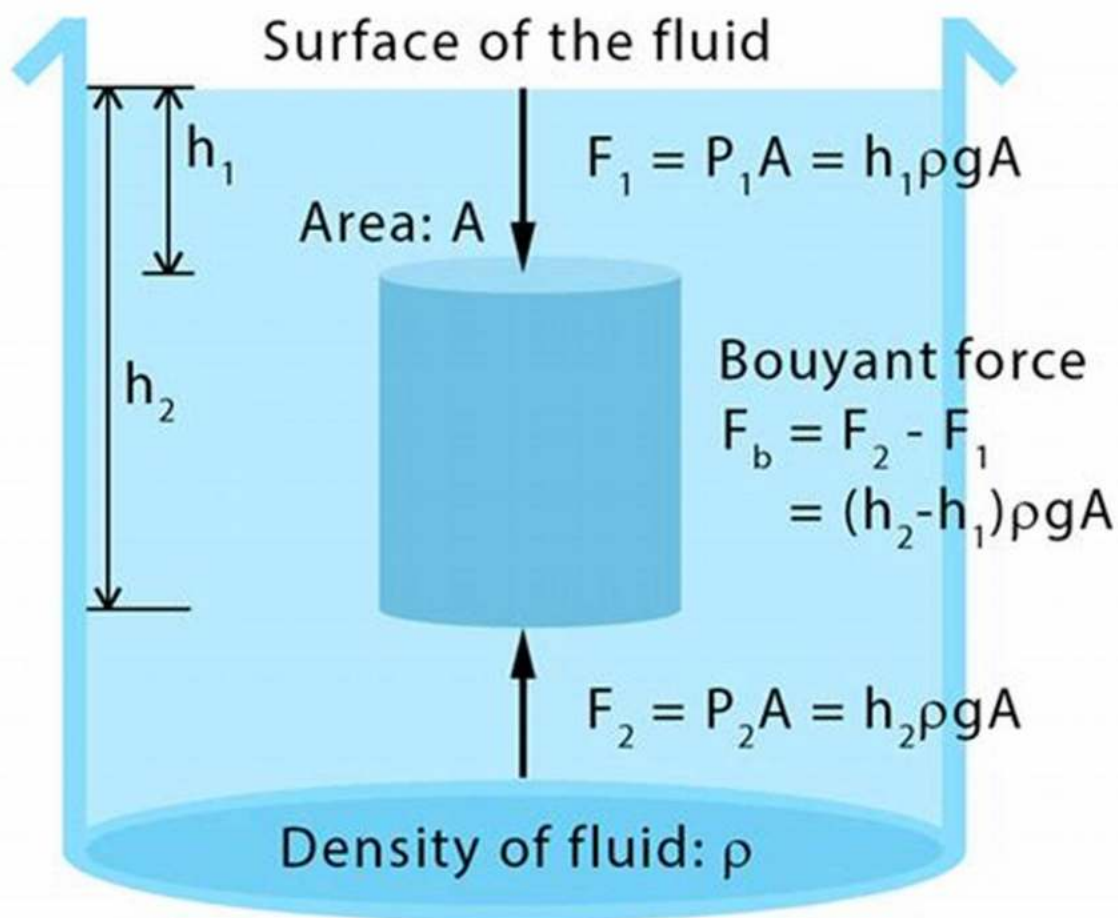


# Archimedes: It's All About the Spin - Revealing the Mind-Blowing Discoveries of the Ancient Greek Mathematician

## Archimedes' Principle Equation



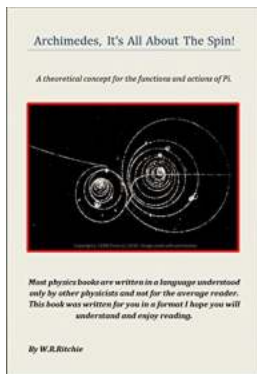
ScienceFacts

Archimedes, the renowned ancient Greek mathematician, engineer, and inventor, stands as one of the brilliant minds that shaped the world of mathematics and

physics. His groundbreaking contributions revolutionized various fields and continue to inspire scientists and mathematicians to this day. In this article, we delve into Archimedes' transformative discoveries and unravel the secrets behind the spin that propelled him to greatness.

## 1. Eureka Moment: The Principle of Buoyancy

Archimedes' "Eureka" moment is undoubtedly one of his most famous anecdotes. The story tells of how he discovered the principle of buoyancy while taking a bath. This principle, also known as Archimedes' principle, states that any object partially or fully immersed in a fluid experiences an upward force equal to the weight of the fluid it displaces.



### Archimedes, It's All About The Spin!

by Roger K. Daneth (Kindle Edition)

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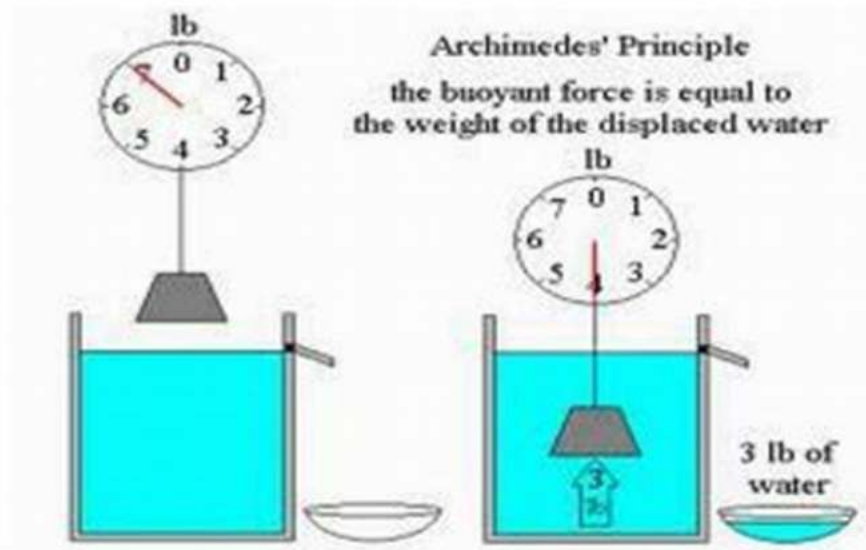


By realizing this, Archimedes unveiled the fundamental concept of buoyancy that proves essential in understanding various phenomena, from the floating of ships to the behavior of hot air balloons.

# Archimedes Principle

## Buoyancy

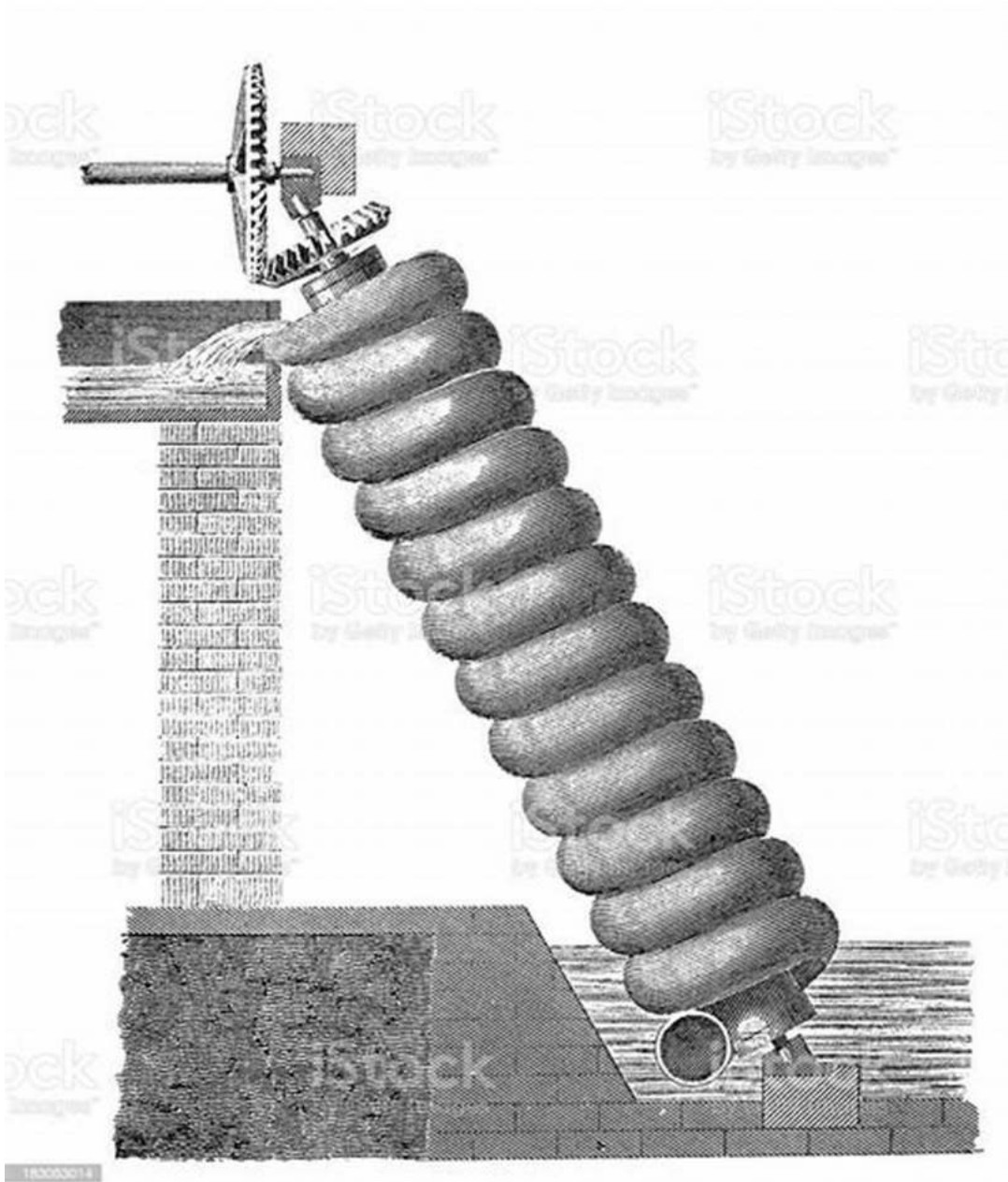
The "upward" force is acting on an object due to the displaced fluid



## 2. Archimedes' Screw: Unleashing the Power of Rotation

Archimedes' screw, also known as the water screw or screw pump, showcases his brilliance as an engineer. This device, consisting of a spiraling tube wrapped around a shaft, functions by rotation to efficiently raise water from lower levels to higher ones.

The Archimedes' screw found widespread usage in irrigation systems, drainage mechanisms, and even mining operations. It represents a remarkable application of the concept of rotation that Archimedes brilliantly implemented to solve practical problems of his time.



### 3. Investigating the Circle: Archimedes' Groundbreaking Work on Pi

Archimedes' mathematical prowess was also evident in his exploration of the circle and its properties. His work on approximating the value of pi, the ratio of a circle's circumference to its diameter, astonished the mathematical world.

Archimedes cleverly used a method of exhaustion, a precursor to calculus, to estimate the value of pi. He inscribed and circumscribed polygons inside and

around a circle, progressively increasing the number of sides to approach a more accurate pi value.

## Finding Pi with Archimedes's Exhaustion Method

Alessandra King

Studying historical puzzles can give students a perspective on the usefulness of math as a tool and on the creative aspects of problem solving. Pi Day offers a wonderful opportunity for such inquiry. My students and I have enjoyed retracing and applying some parts of Archimedes's method of exhaustion to measure the ratio of the circumference of a circle to its diameter. Archimedes lived from 287 BCE until 212 BCE and was one of the greatest mathematicians of all times, as well as an extraordinarily creative problem solver. He formulated how to approximate the circumference of a circle using a sequence of inscribed and circumscribed regular polygons whose perimeters converged to the circumference (see **figs. 1a–b**). His system was a precursor to calculus, specifically the concept of limit, which we briefly discussed at the end of our lesson.

The main objective of this exploration is to show students how formulas came into existence and how they describe clear mathematical relationships. Middle school students are gen-

erally familiar with the formula  $C = \pi d$  that connects the circumference of any circle to its diameter through the constant  $\pi$ . However, they may not always understand its real meaning or may not know how this formula was discovered. As students explore the process that led to the discovery of  $C = \pi d$ , they will develop a better appreciation of the nature of mathematics and of the profound connections between the various areas of this discipline.

Studying math in context gives students the opportunity to participate in real-life problem solving as well as recognize the usefulness of mathematics. This activity can also offer a glimpse into the intellectual development of some fascinating ideas, a closer look at Archimedes's work, and the occasion to think and communicate mathematically about higher-order mathematical concepts.

Ask students to research some aspect of Archimedes's life and the mathematical issues he confronted. Students can then share what they learned with the class. This is generally a well-received activity and a good introduction to the history of mathematics. To calculate the value of pi, my students used a method similar to Archimedes's, although it did not involve applying the great mathematician's precise geometric ratios, concepts well beyond the geom-

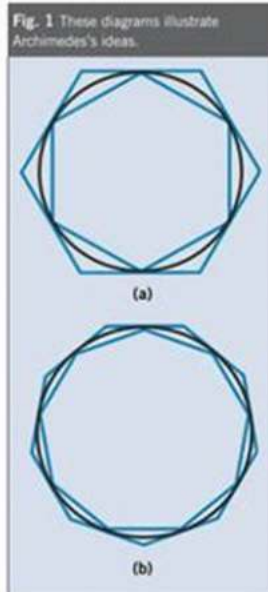


Fig. 1 These diagrams illustrate Archimedes's ideas.

etry knowledge possessed by middle school students. Instead, my students used a more experimental approach by directly measuring the lengths of the sides of the polygons using rulers and yardsticks.

Activity sheet 1 provides

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### 4. Leveraging the Power of the Lever

Archimedes famously stated, "Give me a place to stand, and I shall move the Earth." This assertion highlights his profound understanding of the principles governing levers.



Archimedes explored the concept of leverage and its applications, developing the law of the lever. He demonstrated that by using a lever of sufficient length and a fulcrum, an individual could exert a smaller force to move a larger load.

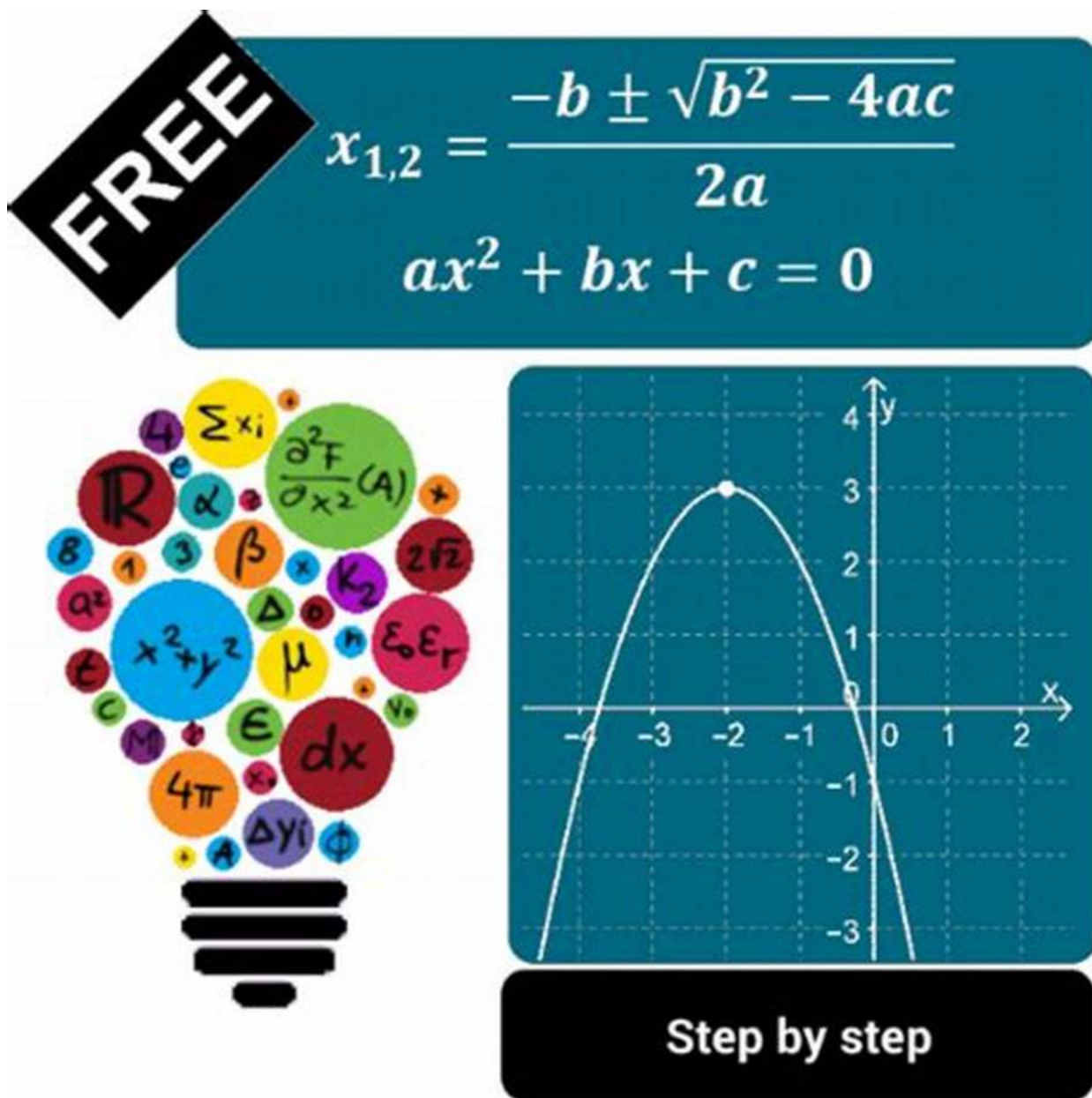


## 5. Quadratic Equations Unraveled

Archimedes played a significant role in advancing algebra as well. He made significant contributions to the solution of quadratic equations, which involve finding unknown values using second-degree polynomial equations.

His work on quadratic equations set the foundation for future mathematicians, paving the way for further developments in the field of algebra and calculus.

Understanding the properties of quadratic equations became crucial in various branches of mathematics and physics.



**FREE**

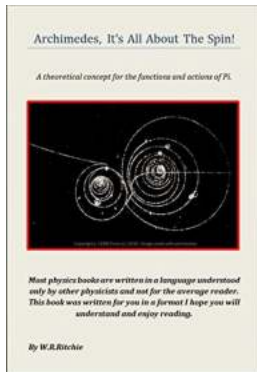
$$x_{1,2} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$
$$ax^2 + bx + c = 0$$

The graphic also features a lightbulb filled with various mathematical symbols and a graph of a parabola opening downwards on a coordinate plane. The parabola's vertex is at (-2, 3) and it passes through the points (-4, -3) and (0, -3).

**Step by step**

Archimedes, with his remarkable intellect and inventive spirit, left an indelible mark on the world of mathematics and physics. His discoveries, ranging from the principle of buoyancy to the manipulation of levers, continue to shape modern science and engineering.

By delving into the mind of this ancient Greek genius, we can gain a deeper appreciation for the power of the human intellect in uncovering the secrets of the universe. Archimedes' spinning ideas and revolutionary concepts have truly transformed our understanding of the world around us.



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A theoretical concept for the functions and actions of Pi.

Pi is not unlike a Mandelbrot expression in its actions and functions.

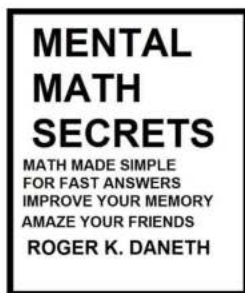
Archimedes himself stated that there may be a more accurate value for Pi, but he was unable to calculate it given the math and technology of the time. This book does not attempt to resolve the value of Pi as a finite number, but more to offer a different perspective and mindset on the approach to its eventual resolution. In this book, I will attempt to explain in both layman's terms, and terms understood by world physicists and mathematicians alike, where Pi starts and where Pi ends, without resolution, as a mathematical constant and irrational number.



Most physics books are written in a language understood only by other physicists and not for the average reader. This book was written for you in a format I hope you will understand and enjoy reading.

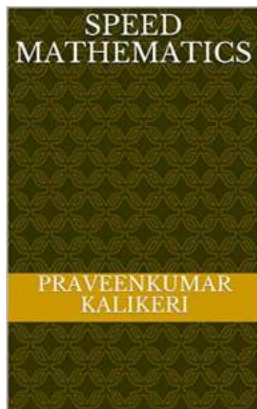
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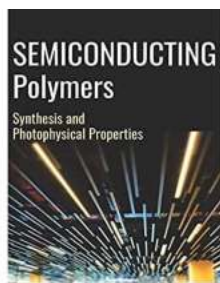
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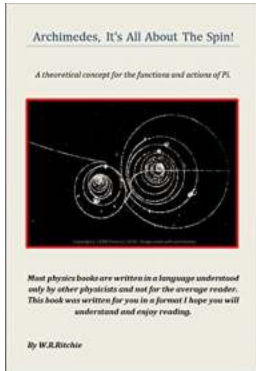


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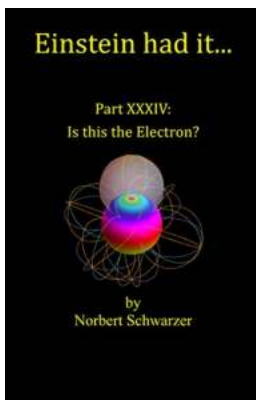
Raquel A. Domingues / Daniel H. A. Cerrêa  
Editors





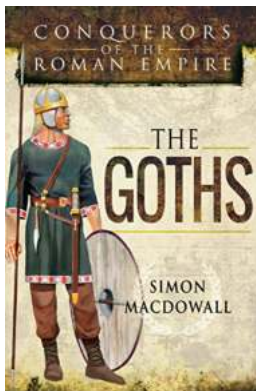
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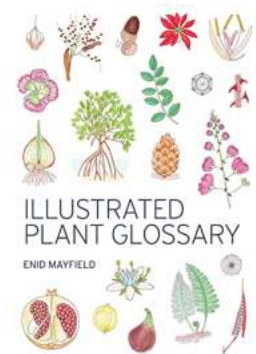
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