

Mathematics in History

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Outline

- 1 Introduction
- 2 The Ancients
- 3 European Mathematics
- 4 The (more) Modern Era

The Nature of Mathematics

Mathematics concerns the fundamental patterns and underpinnings of all things, and methods to break down hard problems to simple ones. As such it is fundamental to physics, which is itself fundamental to Engineering, Chemistry, Biology and more. As such Mathematics turns up everywhere and is an ancient discipline, that is still very much alive.

Babylonians

- The Babylonian civilization extensively used mathematics.
- They used number base 60, as opposed to the ten used elsewhere.
- Can you think where this is still in evidence today?
- They understood **place value** long before it was “discovered” in the west.

Pythagoras of Samos

Greek Mathematician, Mystic (c. 560 - 480 BC)

- founder of a cult that believed in number as the essence of all things;
- among other things, for example, that beans had souls;
- proved the theorem named for him;
- worked on acoustics, showed that halving a stretched string raised the pitch by an octave;
- believed in a spherical Earth;
- believed in a smallest possible number (which implies all numbers are rational);
- was exiled because of suspicion over his cult.

Euclid

Greek Mathematician (c. 300 BC)

- systemized and recorded known mathematics in his books (the elements);
- extended this work too;
- recorded “axioms” of geometry, still used today;
- we still call “normal space” Euclidean space;
- well, until Einstein came long, and we still tend to talk of Euclidean space.
- proved there is no largest prime number;
- still in print today!

Archimedes of Syracuse

Greek Mathematician (272 - 212 BC)

- found many formulae for volumes and areas, without calculus;
- made good estimates for the value of π ;
- developed mechanics, looking at pulleys and levers;
- famous for his “Eureka” moment;
- employed his skills to create weapons to fight off the Roman fleet;
- eventually killed (against orders) by a Roman soldier.

Al-Kwarizmi

Persian (Arabic) Mathematician (c. 800 - 850 AD)

- member of the Baghdad Academy of Sciences;
- wrote a book with a familiar title “Algebra”;
- which contains the quadratic solution formula;
- introduced the Hindu numeral system, now known (incorrectly) as Arabic numbers;
- you know, 1, 2, 3, 4, 5, 6, 7, 8, 9 and zero;
- place value returns, remember the Babylonians?
- from him we get the name “algorithm”.

Sir Isaac Newton

English Physicist and Mathematician (1642-1727)

- discovered Calculus (see also Leibniz);
- Lucasian Professor of Physics at Cambridge at 26;
- Revealed the nature of light in his work in optics, and considered the particle nature of light;
- The Newtonian telescope is named for him;
- Produced a **universal** theory of gravity;
- Developed the famous **laws of motion**;
- Newton's law of cooling is named for him.

Leonhard Euler

Swiss Mathematician (1707-1783)

- The most prolific mathematician of all time;
- The number $e = 2.71828\dots$ is known as Euler's number;
- produced the fascinating identity $e^{j\pi} + 1 = 0$; uniting the five most important numbers in mathematics;
- produced an approximate solution to the three body (Sun, Earth, Moon) system to win a prize from the British Government.
- produced much work in Graph Theory;
- including Euler's rule; for any polyhedron with f faces, v vertices, and e edges $v + f - e = 2$;

Karl Friederich Gauss

German Mathematician (1777 - 1855)

- considered one of the greatest mathematicians of all time;
- a child genius, how fast can you add the numbers $1 + 2 + 3 + \dots + 98 + 99 + 100$?;
- did substantial work of Number Theory;
- the normal or Gaussian statistical distribution is named for him;
- found many results many years before they were officially found by others; ;
- worked on many fields, algebra, arithmetic, astronomy, magnetism; topology and more.

Georg Cantor

German Mathematician (3rd March 1845 6th January 1918)

- performed much work on **set theory**, now the formal basis of mathematics;
- used the idea of one to one correspondence to define counting;
- consequently established that there are many (infinitely many) infinities;
- his work offends many other mathematicians, theologians and philosophers;
- David Hilbert "No one shall expel us from the paradise that Cantor has created".

Alan Mathison Turing OBE FRS

English mathematician (23 June 1912 7 June 1954)

- performed important work as a code breaker in WWII;
- formalised the idea of a computer (Turing Machine);
- the test for the success of AI (artificial intelligence) is named for him;
- called the “father of computing”;
- committed suicide after being prosecuted for homosexuality (then a crime).

Sir Roger Penrose OM FRS

English mathematician / physicist (8 August 1931)

- was responsible for many of the results that only Hawking is known for (in their joint work);
- for example, proved that relativity predicted that stars could collapse to black holes;
- and that time has a start;
- defined “Penrose Tiling” which has been discovered in Islamic Art, and atomic structure;
- worked on the unification of the two great theories of modern physics, General Relativity and Quantum Mechanics;
- has written widely on the nature of human consciousness, and why, in his opinion the current laws of physics cannot describe it.