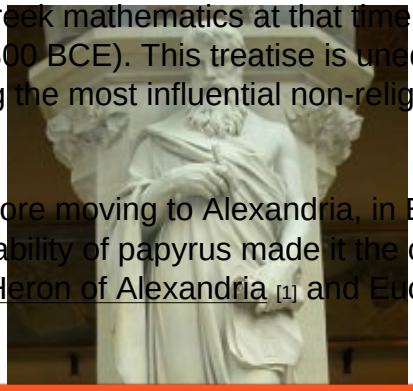
# Euclid, the Father of Geometry

Greek Mathematics

## Greek Mathematics

Euclid enters history as one of the greatest of all mathematicians and he is often referred to as the father of geometry. The standard geometry most of us learned in school is called Euclidian Geometry.



Euclid gathered up all of the knowledge developed in Greek mathematics at that time and created his great work, a book called 'The Elements' (c300 BCE). This treatise is unequaled in the history of science and could safely lay claim to being the most influential non-religious book of all time.

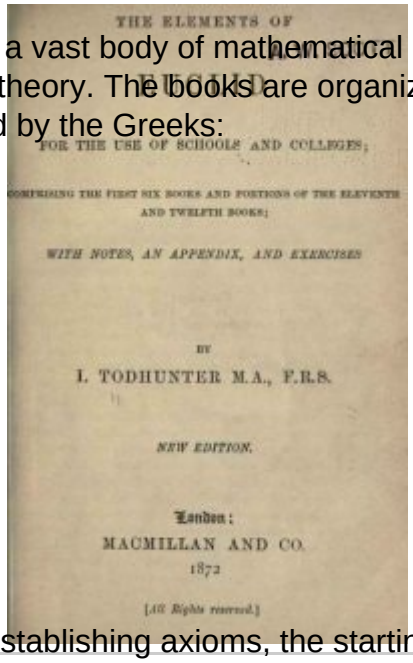
Euclid probably attended Plato's academy in Athens before moving to Alexandria, in Egypt. At this time, the city had a huge library and the ready availability of papyrus made it the center for books, the major reasons why great minds such as Heron of Alexandria [1] and Euclid based themselves there.



## Euclid's Elements

Euclid's great work consisted of thirteen books covering a vast body of mathematical knowledge, spanning arithmetic, geometry and number theory. The books are organized by subjects, covering every area of mathematics developed by the Greeks:

- Books I - IV, and Book VI: Plane Geometry
- Books XI - XIII: Solid Geometry
- Books V and X: Magnitudes and Ratios
- Books VII - IX: Whole Numbers


THE ELEMENTS OF

EUCLID

FOR THE USE OF SCHOOLS AND COLLEGES;

COMPRISING THE FIRST SIX BOOKS AND PORTIONS OF THE ELEVENTH AND TWELFTH BOOKS;

WITH NOTES, AN APPENDIX, AND EXERCISES

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The basic structure of the elements begins with Euclid establishing axioms, the starting point from which he developed 465 propositions, progressing from his first established principles to the unknown in a series of steps, a process that he called the 'Synthetic Approach.' He looked at mathematics as a whole, but was concentrated on geometry and that particular discipline formed the basis of his work.

# Euclid's Axioms

Euclid based his approach upon 10 axioms, statements that could be accepted as truths. He called these axioms his 'postulates' and divided them into two groups of five, the first set common to all mathematics, the second specific to geometry. Some of these postulates seem to be self-explanatory to us, but Euclid operated upon the principle that no axiom could be accepted without proof.

## Euclid's First Group of Postulates - the Common Notions:

1. Things which are equal to the same thing are also equal to each other
2. If equals are added to equals, the results are equal
3. If equals are subtracted from equals, the remainders are equal
4. Things that coincide with each other are equal to each other
5. The whole is greater than the part

The remaining five postulates were related specifically to geometry:

1. A straight line can be drawn between any two points.


2. Any finite straight line can be extended indefinitely in a straight line.


3. For any line segment, it is possible to draw a circle using the segment as the radius and one end point as the center.

From Euclids Elements Book I, Proposition 3(Creative Commons [2])

4. All right angles are congruent (the same).

5. If a straight line falling across two other straight lines results in the sum of the angles on the same side less than two right angles, then the two straight lines, if extended indefinitely, meet on the same side as the side where the angle sums are less than two right angles.

Euclid felt that anybody who could read and understand words could understand his notions and postulates but, to make sure, he included 23 definitions of common words, such as 'point' and 'line', to ensure that there could be no semantic errors. From this basis, he built his entire theory of plane geometry, which has shaped mathematics, science and philosophy for centuries. He proved that it is an impossibility to find the 'largest prime number,' because taking the largest known prime number and adding one to the product of all previous primes and the largest prime will give you another, larger prime number.

# Euclid's Influence

The reason that Euclid was so influential is that his work is more than just an explanation of geometry or even of mathematics. The way in which he used logic and demanded proof for every theorem shaped the ideas of western philosophers right up until the present day. Great philosopher mathematicians such as Descartes and Newton presented their philosophical works using Euclid's structure and format, moving from simple first principles to complicated concepts. Abraham Lincoln was a fan, and the US Declaration of Independence used Euclid's axiomatic system.

Apart from the Elements, Euclid also wrote works about astronomy, mirrors, optics, perspective and music theory, although many of his works are lost to posterity. Certainly, he can go down in history as one of the greatest mathematicians of all time, and he was certainly one of the giants upon whose shoulders Newton stood.

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