

Euclid, The Geometer



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Euclid Of Alexandria

- Where and when he lived?
- Euclid's life as we know it.
- His other works as well as his work on the *Elements*.
- Who Euclid influenced?

His Life.

- Euclid's life still baffles historians.
- There is no record of his time of birth and death.
- "Not much younger than these (sc. Hermotimus of Colophon and Philippus of Medma) is Euclid, who put together the *Elements*, collecting many of Eudoxus' theorems, perfecting many of Theaetetus', and also bringing to irrefragable demonstrations the things which were only somewhat loosely proved by his predecessors. This man lived in the time of the first Ptolemy. For Archimedes, who came immediately after the first Ptolemy, makes mention of Euclid... He is then younger than the pupils of Plato but older than Eratosthenes and Archimedes; for the latter were contemporary with one another, as Eratosthenes somewhere says."

Some Famous Quotes from Euclid

- Ptolemy once asked him if there was any shorter way than that of the *Elements*, and Euclid answered “that there was no royal road to geometry...”
- Euclid was asked by one of his students, which had just learned a new theorem, what he should gain from learning such things, Euclid responded by telling his slave. “Give him three pence, since he must make gain out of what he learns.”

His Education

- It is known that he went to Athens to study at Plato's Academy.
- A theory of the five regular solids was taught by Plato at the Academy and was later used by Euclid in his book the *Elements*.

Euclid and His School

- Euclid and Demetrius Phalereus was invited by Ptolemy 1 to open a school in Alexandria.
- They also ran the Library at Alexandria which was the largest library in the world at that time, containing over 600,000 papyrus rolls.

Euclid's Other Works

- Euclid wrote some other books that are not as well known as the *Elements*. They are as follows: *The Data*, *On Divisions of Figures*, *Phaenomena*, and *Optics*.
- Euclid was also given credit for the works of, *Conics*, *Porisms*, *Pseudaria (Book of fallacies)*, and *Surface Loci*, but were later lost, and we have no proof who wrote them.

The *ELEMENTS*, Euclid's Masterpiece

- This is Euclid's most noted masterpiece.
- It was used in the geometry teachings in the west for over 2000 years.
- The first printed edition was made in Venice in 1482.
- There is 13 books in the *Elements*






Here is an overview of the thirteen books of the *Elements*.

Book	Definitions	Theorems	Problems	Porisms	Lemmas	Includes
I	23	34	14	1	~	basic plane geometry
II	2	12	2	~	~	geometric algebra
III	11	31	6	1	~	circles and angles
IV	7	~	16	1	~	construction of regular polygons
V	18	25	~	2	~	abstract algebra
VI	3	23	10	3	~	similar figures and geometric proportions
VII	22	33	6	1	~	basic number theory
VIII	~	25	2	1	~	continued proportions in number theory
XI	~	36	~	1	~	number theory
X	16	91	24	4	11	classification of irrational numbers
XI	28	34	5	1	1	basic solid geometry
XII	~	16	2	2	2	measurement of solids
XIII	~	12	6	1	3	constructing regular polyhedra
Total	120	372	93	19	16	






Continued

- The *Elements* contained definitions , postulates, axioms, and in depth proofs.
- A postulate is something taken as self-evident or assumed without proof as a basis for reasoning; a proposition that requires no proof, being self-evident, or that is for a specific purpose assumed true, and that is used in the proof of other propositions; axiom.
- There was also the axioms that are defined as a self-evident truth that requires no proof or a proposition that is assumed without proof for the sake of studying the consequences that follow from it.
- Euclid started the *Elements* off with 5 from each of these.

The 5 Postulates

-  To draw a straight line from any point to any point.
-  To produce a finite straight line continuously in a straight line.
-  To describe a circle with any center and distance.
-  That all right angles are equal to one another.
-  That, if a straight line falling on two straight lines, if produced in-definitely, meet on that side on which are the angles less than the two right angles.

The 5 Axioms

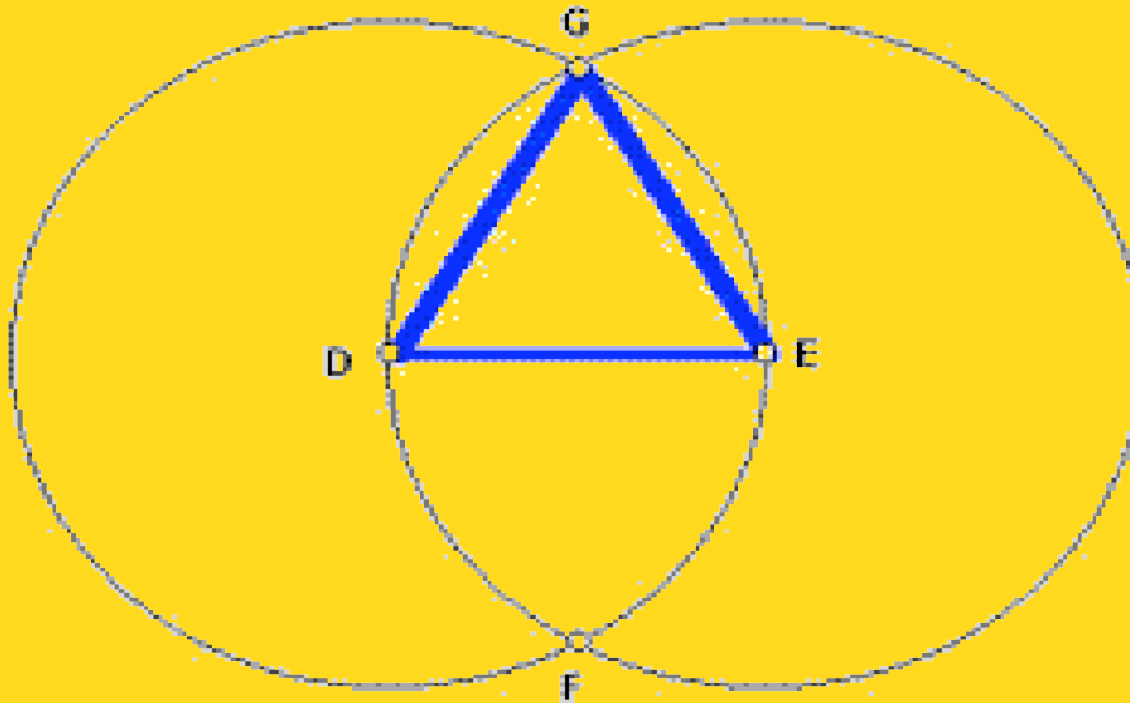
-  Things which are equal to the same thing are also equal to one another.
-  If equals be added to equals, the wholes are equal.
-  If equals be subtracted from equals, the remainders are equal.
-  Things which coincide with one another are equal to one another
-  The whole is greater than the part.

The Books in the *Elements*

- Books 1-6 contained plane geometry.
- Books 7-9 covered number theory.
- Book 10 has the theory of irrational numbers.
- Books 11-13 entail three-dimensional geometry

Book I Proposition 1

- To construct an equilateral triangle on a given finite straight line.
- First you draw a line DE . Then using a compass with the center at D you draw the circle GEF and radius DE . Also set the compass and draw another circle with the center at E producing the circle FDG . Now since G is on the circle GEF and DE is the radius, then $GD = DE$. Same for the circle FDG with the radius ED ; since G is on the circle FDG , then $GE = ED$. From the first axiom we have proven that $GD = DE = GE = ED$. This gives us an equilateral triangle when we on a given finite straight line.



Book VII Proposition 2

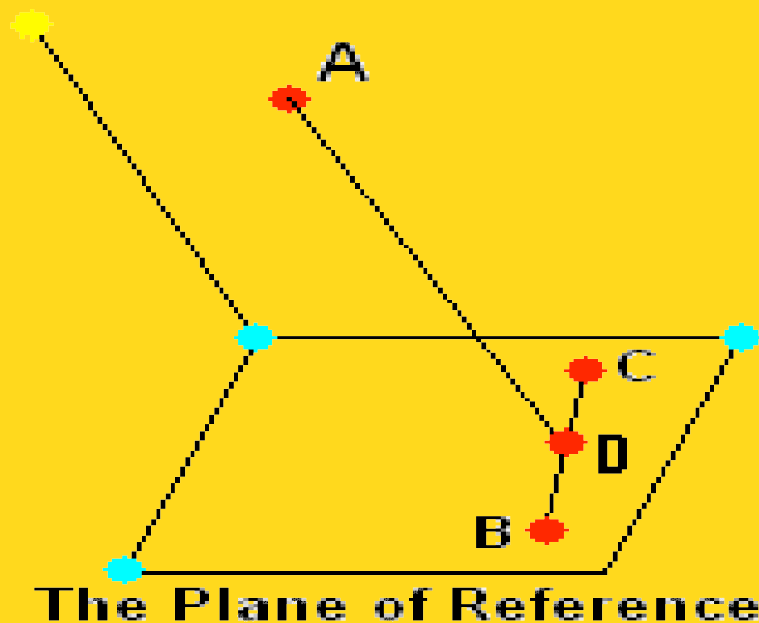
- It states, To find the greatest common measure of 2 given numbers not relatively prime.
- Let AB and CD be the two given numbers not relatively prime. If now CD measures AB , since it also measures itself, then CD is a common measure of CD and AB . If it does not then, when the less of the numbers AB and CD being continually subtracted from the greater, some number is left which measures the one before it. Now let CD , measuring BE . Leave EA less than itself. Let EA measuring DF , leave FC less than itself, and let CF measure AE . Since CF measures AE , and AE measures DF . therefore CF also measures DF . But it measures itself, therefore it measures the whole CD . But CD measures BE , therefore CF also measures AB and CD . Therefore CF is a common measure of AB and CD .

Book X Proposition 15

- This proposition states, if two commensurable magnitudes are added together, then the whole is also commensurable with one of them; and, if the whole is commensurable with one of them, then the original magnitudes are also commensurable.
- Let the two commensurable magnitudes AB and BC be added together. The whole AC is also commensurable with each of the magnitudes AB and BC . Since AB and BC are commensurable, some magnitude D measures them. Since then D measures AB and BC , therefore it also measures the whole AC . But it measures AB and BC also, therefore D measures AB , BC , and AC . Therefore AC is commensurable with each of the magnitudes AB and BC . Next, let AC be commensurable with AB . I say that AB and BC are also commensurable. Since AC and AB are commensurable, some magnitude D , measures them. Since then D measures CA and AB , therefore it also measures the remainder BC . But it measures AB also, therefore D measures AB and BC . Therefore AB and BC are commensurable. Therefore, if two commensurable magnitudes are added together, then the whole is also commensurable with each of them; and, if the whole is commensurable with one of them, then the original magnitudes are also commensurable.

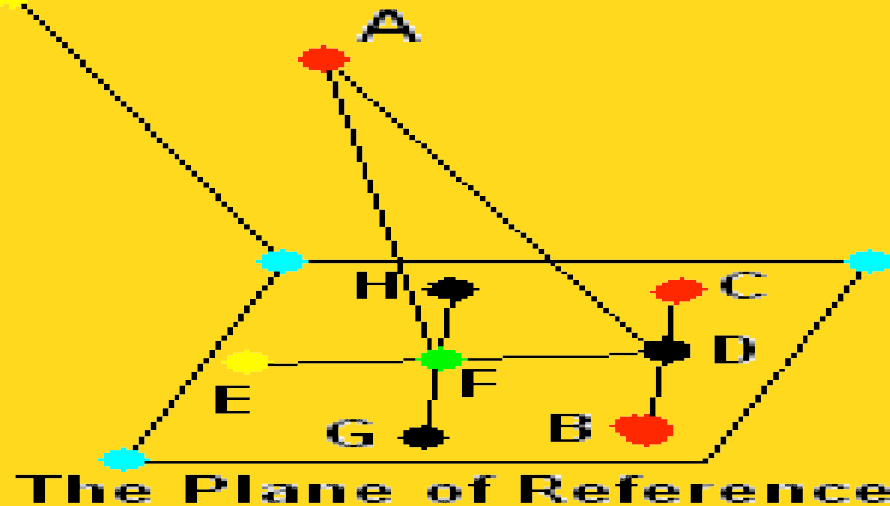
Book XI Proposition 11

- It states, to draw a straight line perpendicular to a given plane from a given elevated point.
- Let A be the given elevated point, and the plane of reference the given plane. It is required to draw from the point A a straight line perpendicular to the plane of reference. Draw any straight line BC at random in the plane of reference, and draw AD from the point A perpendicular to BC . Then if AD is also perpendicular to the plane of reference, then that which was proposed is done.



Continued

- But if not, draw DE from the point D at right angles to BC and in the plane of reference, draw AF from A perpendicular to DE , and draw GH through the point F parallel to BC . Now, since BC is at right angles to each of the straight lines DA and DE , therefore BC is also at right angles to the plane through ED and DA . And GH is parallel to it, but if two straight lines are parallel, and one of them is at right angles to any plane, then the remaining one is also at right angles to the same plane, therefore GH is also at right angles to the plane through ED and DA . And GH is parallel to it, but if two straight lines are parallel, and one of them is at right angles to any plane, then the remaining one is also at right angles to the same plane, therefore GH is also at right angles to the plane through ED and DA . Therefore GH is also at right angles to all the straight lines which meet it and are in the plane through ED and DA . But AF meets it and lies in the plane through ED and DA , therefore GH is at right angles to FA , so that FA is also at right angles to GH . But AF is also at right angles to DE , therefore AF is at right angles to each of the straight lines GH and DE . But if a straight is set up at right angles to two straight lines which cut one another at their intersection point, then it also is at right angles to the plane through them. Therefore FA is at right angles to the plane through ED and GH . But the plane through ED and GH is the plane of reference, therefore AF is at right angles to the plane of reference. Therefore from the given elevated point A the straight line AF has been drawn perpendicular to the plane of reference.



Euclid's Influences




- Alhazen was another mathematician that Euclid influenced. He corrected Euclid's hypothesis on the study of vision.
- Pappus of Alexandria was influenced by Euclid and wrote a book known as Mathematical Collection.
- Leonardo Fibonacci did not agree with Euclid's way of solving equations by square roots, so he devised his own way and wrote it in (Babylonian) sexagesimal notation.

Continued Influences

- He influenced Issac Newton in his theory of gravitational and planetary motion.
- Thomas Jefferson, the 3rd President, studied Euclid while he went to William and Mary University.



EUCLID???

- Since not much is known about Euclid, it didn't take very long for someone to come up with some crazy hypotheses about him, and his name was Itard.
-  Euclid was not a historical character. The 'complete works of Euclid' were written by a team of mathematicians at Alexandria who took the name Euclid from the historical character Euclid of Megara, who had lived about 100 years earlier.
-  Euclid was the leader of a team of mathematicians working at Alexandria. They all contributed to writing the 'complete works of Euclid', even continuing to write books under Euclid's name after his death.
-  Euclid was an historical character who wrote the *Elements* and the other works attributed to him.
- One has to wonder if we have all been tricked by some brilliant ancient mathematicians.

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