

Plane Geometry

Department of Mathematics Education
Faculty of Mathematics and Science
Yogyakarta State University
2014

What is Geometry?

- ❑ Geometry is the study of spatial relationships
- ❑ Geometry is the branch of mathematics that deals with points, lines, planes, and figures, and examines their properties, measurement, and mutual relations in space

What is Geometry?

Geometry can be useful in many fields of work, as well as everyday life. You can find geometric applications in the following situations:

- ❑ Construction
- ❑ Manufacturing
- ❑ Roofing
- ❑ Web page design
- ❑ Computer graphics design
- ❑ etc

Historical Background of Geometry

- ❑ The word geometry is derived from the Greek words *geos* (meaning earth) and *metron* (meaning measure).
- ❑ The ancient Egyptians, Chinese, Babylonians, Romans, Greeks, and Arabics used geometry for surveying, navigation, astronomy, and other occupations.
- ❑ The works men such as Thales (600 B.C.). Pythagoras (540 B.C.), Plato (390 B.C.) and Aristoteles (350 B.C.) in systematizing geometry facts and principles culminated in the Geometry text Elements, written in approximately 325 B.C. by Euclid. This most remarkable text has been in use for over 2000 years.

A Bit of History

Among the mathematical sciences, Geometry is the earliest and historically most influential. The Egyptians and Babylonians knew many geometric facts more than a thousand years before Christ.

A Bit of History

- Geometry first became associated with land measurement in Egypt.
- The Egyptians were obliged to invent it in order to restore the landmarks that were destroyed by the periodic inundation of Nile River.

Herodotus, the Greek historian, gave the following account of the origin of Geometry:

“King Sesostres divided the land among all Egyptians so as to give each a four-sided piece of equal size and draw from each his revenue by imposing a tax to be levied annually. “

Historical Background of Geometry

Egyptian “Geometry” (2000-500B.C.)

- ❑ “Experimentally derived rules” used by engineers
- ❑ The Egyptian Pyramid is evidence of their knowledge of Geometry



Historical Background of Geometry

Babylonian “Geometry” (2000-500B.C.)

- ❑ “Experimentally derived rules” used by engineers
- ❑ Ancient clay tablets reveal that the Babylonian’s knew the Pythagorean relationship.
 - Example: 4 is the length and 5 the diagonal. What is the breadth? It’s size is not known.
 - Solution: 4 times 4 is 16. 5 times 5 is 25. You take 16 from 25 and there remains 9. What times what shall I take in order to get 9? 3 times 3 is 9. 3 is the breadth.

Historical Background of Geometry

Greek "Geometry" (2000-500B.C.)

□ Thales

- Greek historians refer to him as the father of geometry
- Able to determine the height of a pyramid by measuring the length of its shadow at a particular time of day

□ Pythagoras

- Proved that all the angles of a triangle summed to the value of two right angles
- Most famous discovery was the Pythagorean Theorem

Historical Background of Geometry

Arabic “Geometry”

- Thabit ibn Qurra – Omar al-Khayyam – Ibn al-Haytham.
- The Quran strictly banned idol worship and later religious leaders forbade artists from portraying human figures in their art.
- Therefore Muslims art consisted of elaborate geometry patterns.
- They also used calligraphy (the art of beautiful handwriting) extensively and used common phrases of the Quran in their art.



Modern Geometry (1600 – 2000 A.D)

Rene Descartes (1596-1650)

In an appendix "La Geometrie" of his 1637 manuscript "Discours de la method ...", he applied algebra to geometry and created analytic geometry.

A complete modern English translation of this appendix is available in the book The Geometry of Rene Descartes



PIERRE DE FERMAT (1601 – 1665)

Is also recognized as an independent co-creator of analytic geometry which he first published in his 1636 paper "Ad Locos Planos et Solidos Isagoge".

He also developed a method for determining maxima, minima and tangents to curved lines foreshadowing calculus. Descartes first attacked this method, but later admitted it was correct.



GIRARD DESARGUES (1591 – 1661)

Invented modern projective geometry in his most important work titled "Rough draft for an essay on the results of taking plane sections of a cone" (1639).

His famous 'perspective theorem' for two triangles was published in 1648.



Blaise Pascal (1623-1662)

- He was the co-inventor of modern projective geometry, published in his "Essay on Conic Sections" (1640).
- He later wrote "The Generation of Conic Sections" (1648-1654).
- He proved many projective geometry theorems, the earliest including "Pascal's mystic hexagon" (1639).





Leonhard Euler

(1707-1783)

He discovered (1752) that the well-known "Euler characteristic" ($V-E+F$) of a polyhedron depends only on the surface topology. Euler, Monge, and Gauss are considered the three fathers of differential geometry. He also made breakthroughs contributions to many other branches of math. A representative selection of his discoveries is given in **Euler: The Master of Us All**.



Gaspard Monge

(1746-1818)

He is considered the father of both descriptive geometry in "**Geometrie descriptive**" (1799); and differential geometry in "**Application de l'Analyse a la Geometrie**" (1800) where he introduced the concept of lines of curvature on a surface in 3-space.



Carl Friedrich Gauss

(1777-1855)

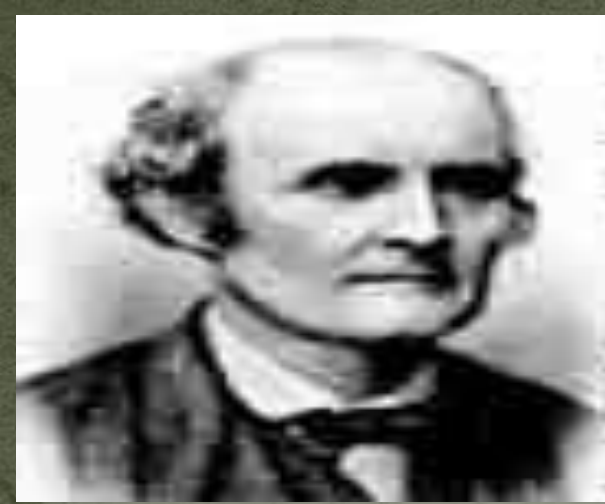
He invented non-Euclidean geometry prior to the independent work of Janos Bolyai (1833) and Nikolai Lobachevsky (1829), although Gauss' work was unpublished until after he died. With Euler and Monge, he is considered a founder of differential geometry.



Hermann Grassmann

(1809-1877)

He was the creator of vector analysis and the vector interior (dot) and exterior (cross) products in his books "Theorie der Ebbe and Flut" studying tides (1840, but 1st published in 1911), and "Ausdehnungslehre" (1844, revised 1862).



Arthur Cayley

(1821-1895)

He was an amateur mathematician (a lawyer by profession) who unified Euclidean, non-Euclidean, projective, and metrical geometry.



Bernhard Riemann

(1826-1866)

He was the next great developer of differential geometry, and investigated the geometry of "Riemann surfaces" in his PhD thesis (1851) supervised by Gauss. In later work he also developed geodesic coordinate systems and curvature tensors in n -dimensions.



Felix Klein

(1849-1925)

He is best known for his work on the connections between geometry and group theory. He is best known for his "Erlanger Programm" (1872) that synthesized geometry as the study of invariants under groups of transformations, which is now the standard accepted view.



David Hilbert

(1862-1943)

His first worked on invariant theory and proved his famous "Basis Theorem" (1888). He later did the most influential work in geometry since Euclid, publishing "Grundlagen der Geometrie" (1899) which put geometry in a formal axiomatic setting based on 21 axioms.



Oswald Veblen

(1880-1960)

He developed "A System of Axioms for Geometry" (1903) as his doctoral thesis. Continuing work in the foundations of geometry led to axiom systems of projective geometry, and with John Young he published the definitive "Projective geometry" (1910-18).



Donald Coxeter

(1907-2003)

He is regarded as the major synthetic geometer of the 20th century, and has made important contributions to the theory of polytopes, non-Euclidean geometry, group theory and combinatorics.



WHY DO WE
NEED TO
STUDY
GEOMETRY?

We Have to Study Geometry to

Provide us with many
important facts of practical
value



We Have to Study Geometry to



Understand and appreciate our
natural and man-made environment

We Have to Study Geometry to

Enhance our
analytical skills to
express our
thoughts accurately
and train us to
reason logically

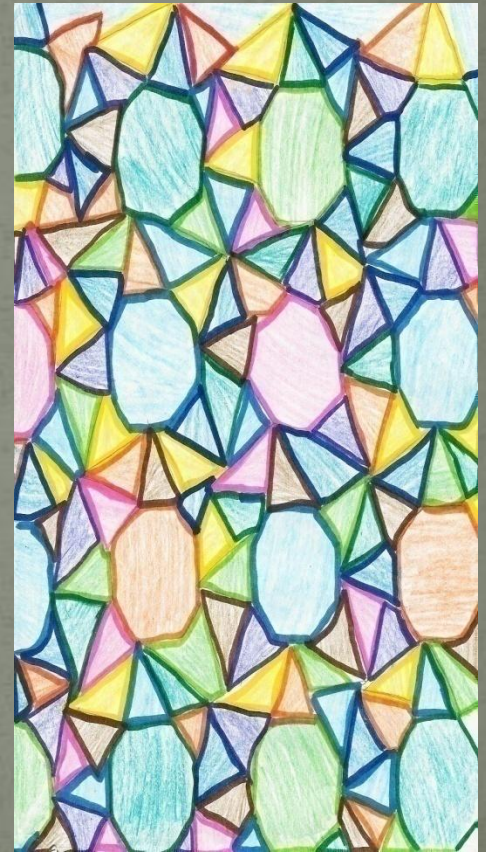


A knowledge of basic geometry is useful to everyday life, particularly in measuring and designing such items as ...



Room Carpeting

Tessellation Patterns



Painting of House

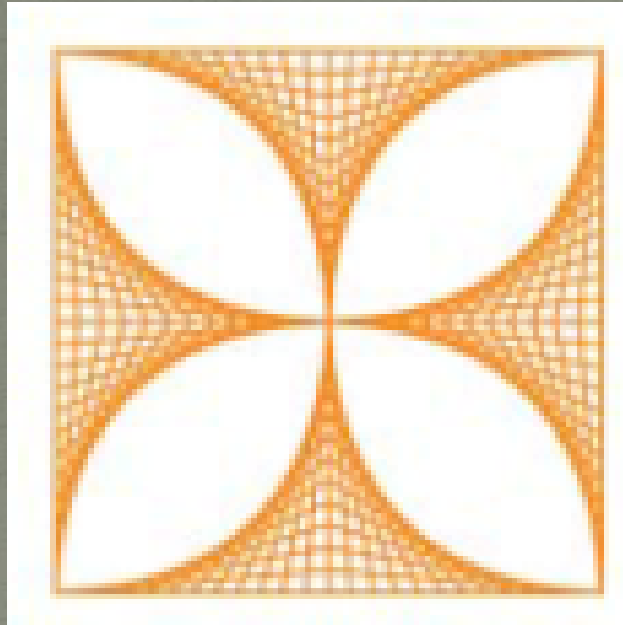


Constructing of Picture Frame

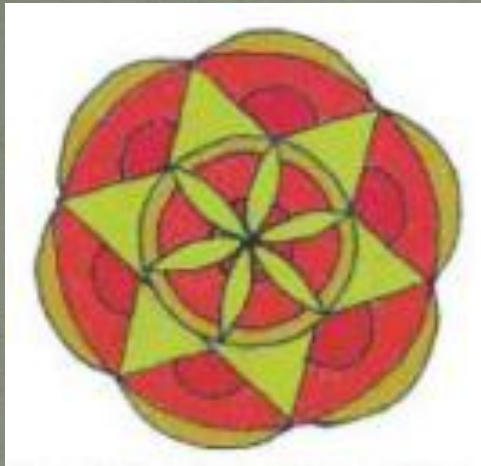


Etc.

The Examples of Geometry Design



The Examples of Geometry Design



Make your own design !
