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ABSTRACT
        This document is one of six which set forth the
mathematics components of the Project SEARCH Articulated Curriculum
developed by the Utica (New York) City School District. Each volume
deals with a broad area of mathematics and lists objectives related
to that area for all grades from K through 12. Each objective listed
is described first in general terms and then in terms of specific
skills which students should exhibit. This volume concerns geometric
concepts, theorems, and methods, including trigonometry and a few
topics from the calculus. (SD)

Utica City School District

Articulated Curriculum

Project Search

1975

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This Articulated Curriculum is being printed and bound in this manner to provide for on-going revision. This also serves as evidence of work completed during Phase III of Project SEARCH.

MATHEMATICS

K - 12

Geometry

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PROJECT SEARCH

ARTICULATED CURRICULUM

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August 1975

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MRS. ROSE ZANELLA and NORMAN I. SIEGEL, both former Board Members deserve
special mention for all their efforts on behalf of Project SEARCH.

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MATHEMATICS

Definitions

The student will know:

- the physical shapes of circles, rectangles, squares, and triangles.

- the basic properties of circles, squares, rectangles, and triangles.

- the properties of parallel lines.

- the concept of infinite lines.

- the names of simple geometric figures.

- that a point is a position without length or width usually represented by a dot.

- that a line is a series of points connected by a long narrow mark.

- that a line segment is a part of a line with two definite end points.

- that a ray is part of a line with one definite end point.

- that an angle is formed by two rays with a common point.

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GEOMETRY

The student will:

Grade K

- identify objects having circular, rectangular, square and triangular shapes.

Grade 1

- identify circles, squares, rectangles, and triangles according to basic properties, when given pictures.

Grade 2

- be able to recognize and draw parallel lines.

- describe the concept of infinite lines.

- be able to write geometric names when given geometric figures.

Grade 3

- be able to make a point and draw many lines through it.

- be able to draw a line through a series of points.

- name a line segment given a line broken into many lines.

- draw a ray given one end point.

- be able to place a point on paper and draw two rays from this point thus forming an angle.

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- the definitions of closed curves, circles, open curves, polygons, triangles, quadri-laterals, rectangles and squares.

- draw an example of closed curve, circle, open curve, polygon, triangle, quadrilateral, rectangle and square.

- identify each of them.

- the meaning of pentagon, hexagon, perpen-diculars, spheres, planes, symmetry and lines of symmetry.

- match geometric figures with definitions.

- the definitions of prism and cyclinder.

- recognize and name the shape of a prism and cyclinder.

- the construction of hexagon, equivalent triangle.

- construct a hexagon and equivalent triangle.

- the bisection of a line segment.

- construct the bisection of a line segment.

- the definitions of trapezoid and its legs, chord, diameter, radius, arc, sector, and segments, and parallelogram.

- describe a trapezoid and its legs, diameter, chord, radius, arc, sector and segments, and parallelogram.

- the symbols for congruency, similarity, equivalency, triangle, circle and angle.

- use the symbols in arithmetic sentences.

Congruency and Similarity

- the circumference of a circle.

- find circumference of a circle with the formula.

- the area is the measure of the interior of a plane figure.

- find the area of closed plane figures using formulas.

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- the volume is the measure of the interior of a solid figure.

- the classification of a point.

- the classifications of lines.

- the classifications of angles.

- the classification of a plane.

- the illustrations for:

- the properties of and classification of geometric figures.

- the components of a circle.

- the classifications of triangles.

- find the volumes of rectangular shapes. —

Grade 7

- describe and recognize a point.

- describe and recognize a line, line segment ray, interesecting lines, parallel lines, perpendicular lines. Describe and recognize horizontal, vertical and slanted lines.

- recognize vertical and adjacent angles.

- describe and recognize obtuse, acute, right, straight angles according to their sizes.

- describe and recognize a plane.

- draw and recognize correct symbol for a line <->, angle L, ray --->, segment — , parallel //, interesecting X ,
- recognize, draw, identify all regular polygons that have 4 - 10 sides.

perpendicular ⊥

- will find and recognize the verticals and diagonals of a given polygon.

- describe, recognize parts of a circle center point, radius-diameter-chord.

- recognize, describe acute, right, obtuse triangles (classified by their angles).

- recognize, describe scalene, isosceles, equa- lateral triangles (classified by sides).

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- the symbols for triangles and quadrilaterals.

- the construction and measurement of geometric figures.

- that the perimeter of regular polygons is the measure around it.

- that the area of polygons is the measure of its interior

- recognize and draw correct symbols for all triangles ∠, quadrilaterals
  1) rectangle ▱   2) square □
  3) parallelogram ▱   4) rhombus ◇
  5) trapezoid ▱
  (must instruments: compass, straightedge protractor).

- given a diameter or radius students will construct a circle.

- to measure to the nearest degree any given angle 60° - 180°.

- by using a compass, protractor, straightedge:
  -construct right, obtuse, acute angles
  -bisect an angle
  -bisect a line segment, constructing a line segment
  -construct congruent angles
  -construct perpendicular lines
  -construct parallel lines.

- be given the dimensions necessary for finding perimeter students will calculate its perimeter.

- recognize formula for each polygon and calculate, given its dimensions, the area of that polygon.

rectangle — base-altitude (height)   b.a.
parallelogram—base-altitude (height)   b.a.
square—base-altitude (height)   b.a.
rhombus—base-altitude (height)   b.a.
trapezoid   altitude (base + base) $A = \frac{b.a.}{2} (b + b')$
                    2

triangles — $\frac{\text{base altitude}}{2}$ $\frac{b.a.}{2}$

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the circumference and area of circle.

- recognize the diameter or radius of a circle will calculate the circumference π-d or $2\pi r$, and the area πr^2 of any circle.

- list, recognize and name appropriate symbols of geometry.
- recognize and know the meaning of geometric terms.

the meaning of the following geometrical terms: altitude, - Angle: acute, adjacent, bisector, central, complementary, congruent, cosine of, inscribed, obtuse, right, sine of, supplementary, tangent of, vertical - Area: of a circle, parallelogram, rectangle, regular polygons, trapezoid, triangle - Axis - Circle: arcs, area, chord, circumference, circumscribed, diameter, graph, inscribed, radius, secant, sector, tangent, - cone- Construction: bisecting an angle, bisecting a linesegment, circumcircle, congruent triangles, incircle, parallel lines, perpendicular lines, - Cylinder - Deductive reasoning Directed line segments Hypotenuse - Inductive reasoning - Line(s): graph, intersecting, parallel, perpendicular, perpendicular to a plane - Line Segments: congruent. directed - Measure(s): angles, line segments - midpoint- Parallel Lines: alternate interior/exterior angles, corresponding angles, transversal - parallelogram - perimeter - P: - Planes - Points, geometric: betweeness, collinear - Polygonal region - Polygons: area, diagonals, perimeter, Polyhedrons: prism, pyramid - prism, pyramid - Prism: right, surface area, volume - Pyramid: regular, area, volume - Pythagorean therom - Quadrants - Ray - Rectangle Rectangular Solid - Rhombus - Right triangle Slope of a line - Sphere: area, circles of, volume - square - supplementary angles - Tangent: acute angle, to a circle, table of values.

Trapezoid - Triangle(s); acute, angle, attitude, area, circumcircle, circumscribed, congruent, equalateral, incircle, inscribed isosceles, obtuse, perimeter, right, right isosceles, scalene, similar, 30-60 right - Volume: cone, cylinder, pyramid, rectangular solid, sphere - and the following symbols: = equal to, < less than, not equal, > greater than, ∠ less than or equal, ≠ greater than segment AB, CD line CD, CD; ray CD, ∠ ABC angle ABC, M (AB) measure of line segment AB, is congruent to, M ∠ EKF measure of angle EKF, is perpendicular to, △ ABC, triangle ABC, || parallel to, GJ minor are GJ, GHJ major are GHJ.

– the basic properties of congruence as applied to line segments: that line segments having the same measure are congruent ___ angles: that angles having the same measure are congruent triangles: that if the triangles corresponding angles and corresponding sides are congruant than the triangles are congruent (and vice versa).

– that the classical restrictions on geometric construction are the use of only a straight edge and compass.

– that in deductive reasoning certain general statements, called assumptions, assumed to be true, provide evidence that other statements, called conclusions, are also true.

– the related concepts of the relationships of space as applied to perimeter, area and volume.

– gain an intuitive understanding of congruent line segments, angles and triangles.

– develop means to construct various geometric constructions such as congruent line segments, angles and triangles.

– reason from stated definitions and assumptions and deduce conclusions to informed geometric problems.

– utilize the concepts of sets and subsets, of geometric figures and the formulas for perimeter, area and volume.

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- that if the corresponding angles of two triangles are congruent and the measures of the corresponding sides are proportional, then the triangles are similar.

- that $c^2 = a^2 = b^2$ is the general form of the Pythagarean Property and that it is applicable to the solution of practical applications problems.

- the basic geometric shapes

- the relationship between the parts of a figure and the whole figure.

- the formulas for circumference and area of a triangle is 180°, complementary angles are two angles whose sum is 90°, and supplementary angles are two angles whose sum is 180°.

- how to solve algebraic problems relating to geometry.

- the Pythangorean Theorem and its use in solving right triangle problems

- the formulas for circumference and area of a circle, the perimeter and area of a polygon.

- show how the proportionality of the sides of similar triangles would lead to the solution of practical problems.

- discover the Pythagorean Property by the determination of the area of three squares each of which has as a side, one side of the right triangle and from this the application to a specific right triangle with, for example sides of 3, 4 and 5 units.

- extend the concepts of the Pythagorean Property to include all right triangles and associated practical application problems.

Grade 9

- construct designs using the basic geometric shapes.

- construct an entire figure given the pieces of the figure.

- Find the angle of a triangle given the other two, find the complement of an angle and find the supplement of an angle.

- solve algebraic equations relating to geometry

- solve right triangles using Pythagorean Theorem.

- write the formulas for area and circumference of a circle, the perimeter and area of a polygon

- that computers are a 20th century technological advancement and have an infinite number of uses in the world.

- that computers do not always make positive contributions to society.

- that computers play an important part in his every day life.

- that computers cannot solve all problems

- that computers can be used in subject areas that are now math-science oriented.

- the method of writing a formal proof from a verbal statement.

- the theorems and/or postulates for proving triangles congruent.

- the theorems involving similarity.

- the theorems involving similar right triangles.

- the basic constructions

- the fundamental locus theorems.

- list 10 uses of the computer.

- make an evaluation of the pros and cons of computers.

- list 10 ways in which computers or their output are used by him.

- select a real-life problem and explain why there can be no computer solution.

- write several programs which find solutions to high school non-Math, non-Science problems.

Grade 10

- write a demonstration of a formal proof given a verbal statement.

- prove triangles congruent. Prove line segments and/or angles congruent using congruent triangles.

- prove triangles similar.

- prove corresponding sides of similar triangles are in proportion. Find the length of the hypotenuse, leg, altitude or projection of a leg given values for 2 or 3 of the other parts.

- construct a given figure based on given facts.

- describe the locus of points given a condition or set or set of conditions.

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- the basic theorems concerning circles.

-the theorems and postulates regarding parallelism

- the classification of angles

- the relationships between lines

- the different types of polygons

- the perimeter of polygons

- the area of polygons

- the circles

- the basic geometric constructions

MATHEMATICS

- the definitions of the 6 trigonometric functions: sine, cosine, tangent, cotangent, secant, and cosecant.

- the relationship between a trigonometric function and the terms form, amplitude and period.

- prove arcs, angles chords, and other circle-related figures congruent.

- prove lines parallel given a verbal statement involving two lines cut by a transversal.

ADVANCED FOUNDATIONS

Grade 10 - 12

- define angle types (acute, right, obtuse, straight and reflex) by their measure.

- Identify perpendicular, parallel, coincident and intersecting lines.

- Identify the polygon types by the number of sides, measure of angles and length of sides.

- calculate perimeters of different polygons

- calculate areas of different polygons

- calculate circumference and area of a circle

- construct angle and line segment bisectors

GEOMETRY

Grade 11

- find the values for the six trigonometric functions given a or table of values.
  b) express an angle in degrees and in radians.
  c) name the values of the 6 trigonometric functions for angles which are multiples of 45° and 30°.

- graph a trigonometric function (eg. $y = sinx$) considering its form, amplitude and period.

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- the definition of an inverse trigonometric function.

- the rules for expressing a function of an angle greater than 90° in terms of a function of an acute angle.

- the identities of the sine, cosine and tangent functions (sum and difference of 2 angles, double, half-angle identities, and other basic identities).

- the law of sines and cosines of triangles, i.e. $a^2 = b^2 + c^2 - 2ab \cos c$ & $\dfrac{\sin A}{a} = \dfrac{\sin B}{b} = \dfrac{\sin C}{c}$

- the area formula for the area of a triangle: $A = 1/2\ ab \sin C$.

- the geometric definition of the Conic Section –
  a) circle   c) parabola
  b) ellipse   d) hyperbola

- graph an inverse function.

- express in writing a function of an angle greater than 90° in terms of a function of an acute

  e.g. $\sin 210° = \sin 30°$.

- derive each of the identities in written form.
- prove other identities using the basic ones.

- solve a triangle for various sides and/or angles given certain sides and/or angles.

- find the area of a triangle given 2 sides and an included angle using this formula.

Grade 12

- derive the standard form of the equation of each of the conic sections by using the geometric definition of each.

- derive the general form of each equation of each conic section and compare these results with the overall general quadratic equation. From these individual general equations the student will list those characteristics that must serve as unique means of conic section identifications.

- show correlation between the above, and from this correlation will prepare and list the raw data that will comprise inputs to a computer, in a computer oriented environment.

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- the meaning of vector notation for finding; distances between 2 points, distances between a point and a line, and determining whether 3 points are colleanear or not.

  - find the distances between a point and a line, using vector notation.

- the method to find the slopes of vector and the method to write a vector equation.

  - find the slope of vector and determine whether or not they are intersecting or non-intersecting vectors.

- the method to prove geometric theories by plane analytical geometry notations and/or vector notations.

  - prove a geometric theorem using plane analytical geometry notation or vector notation.

- the solution of triangles by using the law of lines or the law of cosines.

  - determine the side of a triangle given two angles and a side of a triangle.

- the method of changing rectangular coordinates to polar coordinates.

  - plot a point given its polar coordinates and find the rectangular coordinates of that point.

- the method of changing complex numbers in the form a + b to polar form.

  - write a + b form a complex number given its absolute value and amplitude.

- the increment method of finding the first dirivation.

  - Find $\Delta y = \lim \left(\dfrac{fx - f(\Delta x)}{\Delta x} \right)$

- the chain rule of differentation

  - find $\dfrac{dy}{dx}$ if $y = s2 + 4s$ and $s=3x$

- differentation of polynomials

  - find the first and second dirivatives of a fourth degree polynomial.

- the relation between polynomial function and its graph

  - show that the function $f(x) = -z^3 -2x^2 + x - 3$ has at most one real zero.

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A. P. MATH

- the characteristics of specific geometric figures: lines, triangles, parallelograms, regular polygons, trapezoids, cubes, parallelepipeds, cylinders and cones.

    - apply the characteristics of specific geometric figures in solving problems.

- the conic figures from their equations.

    - identify conic figures from their equations.

- the important points of conic figures i.e. axis of symmetry, center, vertices, foci; directrix; also eccentricity and asymptotes from the equations.

    - find axis of symmetry, center, vertices, asymptotes, directrix, foci, eccentricity of conic figures from their equations.

- the application of formulae learned in Math 10, 11, and 12X.

    - apply formulae learned in Math 10, 11, and 12X.

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