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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 covers topics related to measurement. These include money, calendar, time, temperature, weight, linear measure, liquid measure, area and volume, error of measurement, and techniques of graphing and interpreting graphs. Both metric and English systems of measurement are used. (SD)

Utica City School District

Articulated Curriculum

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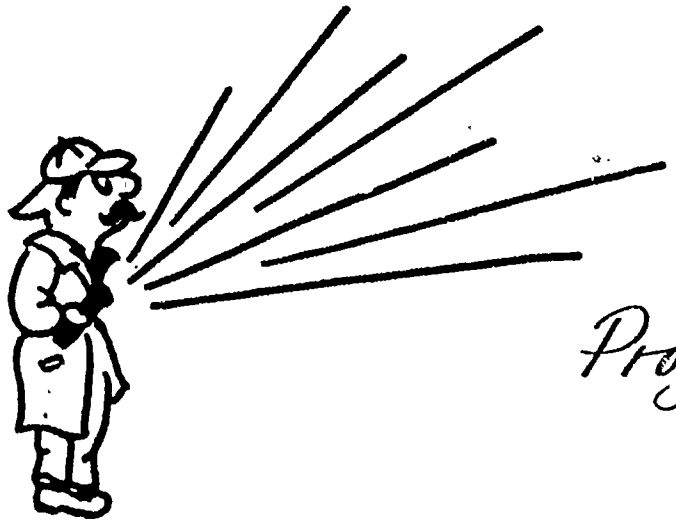

Project Search

1975

Draft Copy

FORWARD

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

MEASUREMENT

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PROJECT SEARCH

ARTICULATED CURRICULUM

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August 1975

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

UTICA CITY SCHOOL DISTRICT
13 Elizabeth Street
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MATHEMATICS

MEAS

Grade K

The Student Will Know:	The Student Will:
Money	
- the names of penny, nickel, dime and quarter.	- identify by name the real coins - penny, nickel, dime and quarter.
Time	
- the numerals on the clock relate to telling time.	- find position of numerals on a clock.
- the hour and minute hands on the clock.	- identify the numerals to which the hand points.
Temperature	
- the position of the mercury indicates the temperature.	- use a movable thermometer to move the mercury indicator up when hot and down when cold.
Linear	
- the meaning of length as being long or short.	- compare length of two objects using the terms long and short.
- that the ruler, yardsticks and/or meter stick are used for measuring lengths.	- use the ruler, yardstick, or meterstick to measure objects showing only how many ruler lengths it takes.
- the comparative sizes of large and small.	- compare size of various objects or sets using the terms large, small, larger, smaller, etc.
Liquid	
- the meaning of empty and full.	- identify containers which are full of liquid and those which are empty.
Weight	
- the meaning of the terms heavy and light.	- determine which of two objects is heavy and is light.
Calendar	
- the names of the days of the week in the proper order.	- recite days of week in order.

Grade 1

Money	
- the monetary value of penny, dime, nickel, quarter.	- name each real coin, penny, dime, nickel, quarter and tell its value in cents.
- the equivalent coin combinations for nickels, dimes, and quarters.	- find equivalent coin combinations for nickel, dime, and quarter from among real or play coins.
- that the sign ¢ is used to show cents.	- write money sums using the sign ¢.

Time	**Grade 1**
- the correct positions of the hours 1-12 on the face of the clock	- fill in a clock face with numerals 1-12 in proper positions.
- the time in hours on the clock face.	- tell and/or draw in designated time in whole hours on a clock face.
Temperature	
- the association of high numbers with heat and low numbers with cold.	- record and compare various temperatures identifying the higher with warm conditions and the reverse.
Linear	
- the ruler divisions of inches and/or centimeters.	- identify unit divisions on a ruler as inches or centimeters.
Liquid	
- that volume is measured in terms of cups, pints, and quarts and/or liters in metrics and to know their relations to each other in terms of larger than or smaller than.	- state which liquid measure has more volume when presented with two different measures (ex. Which is larger a cup of water or a pint?)
Weight	
- that pounds and/or grams are units of weight as measured by a scale.	- weigh and record weight of various objects on a scale in terms of pounds or grams.
Calendar	
- the names of months of the year in proper order.	- recite months of the year in order.
Money	**Grade 2**
- the names and monetary value of half-dollars and dollar bills.	- identify a dollar and half-dollar and be able to state their value in cents.
- the various equivalent coin combinations for half-dollar and dollar.	- find equivalent coin combinations for half-dollar and dollar.
- the various combinations of coins up to 99 ¢	- use pennies, nickels, dimes, and quarters to find sums that do not exceed 99¢.

Time	
- the time in ½ hours on the clock face.	**Grade 2** - fill in a clock face with the designated time on the ½ hour.
Linear	
- that objects can be measured in terms of inches, and half inches or centimeters and milimeters, etc.	- measure with inch or centimeter ruler given objects in inches, ½ inches, or centimeters and milimeters.
Liquid	
- the equivalent values of cups, pints and quarts and/or liters.	- demonstrate the equivalent volume measures of cups, pints, liters.
Calendar	
- the date to day calendar relationship.	- find a specific date on a calendar.
Money	**Grade 3**
- the money signs $ and (dollar sign and decimal point).	- write examples of money values or notations using appropriate sign.
Time	
- the relationship between hour, ½ hour, ¼ hour, with 5 minute and 1 minute intervals	- designate specific times given by drawing them in on the face of a clock.
- the equivalents of hour, ½ hour and minutes.	- make as many equivalent combinations as possible.
- sequence of time as related to earlier or later.	- state what time will be earlier or later than a state time (within the hour).

Temperature	
- that a thermometer is divided into units called degrees.	- read and record temperatures using degree symbol.
- the number of inches in a foot, number of feet in a yard, number of inches in a yard	- recite facts - write in answers to complete statements.
- the concept of length of lines may be measured to nearest inch.	- will measure lines or objects to nearest inch correctly.
- that units of measure are standard.	- compare equivalent units of measure on different scales (ex. an inch on a yardstick).
- that word problems can be written involving units of linear measure.	- compare an original problem involving these terms and demonstrate ability to solve.
Liquid	
- the equivalent measures for a gallon.	- use concrete or abstract materials to formulate a list of equivalent combinations to a gallon.
- that word problems can be written using liquid measures.	- compse original problem involving these terms or solve one already written.
Weight	
- the meaning of the terms, ounces, pounds and tons.	- identify items that can be measured in these units.
- the equivalence of ounces to pounds.	- recite ounce equivalent to pounds.
Calendar	
- the number of days in a week, month, in a year and hours in a day.	- construct a calendar and use a claendar to project future time.
- the equivalence of times.	- make as many equivalent combinations for periods of days and weeks totaling months.

	Grade 4
Money	
- the process for making change using the additive approach.	- make correct change using concrete and abstract materials.
- the various bills up to $50.00	- identify correctly bills up to $50.00
- the equivalent combinations of bills and coins up to $50.00	- make various equivalent combinations of bills and coins up to $50.00.
- that money values can be operated on (+, -, x, ÷) in both vertical and horizontal forms.	- solve equations and/or examples using money values.
Time	
- the meaning of and difference between A.M. and P.M.	- state behaviors appropriate to certain times of day, when given times written with A.M. and P.M. designations.
- the meanings of dates written the short way. (ex. 5/29/75)	- write specific dates in the correct form.
Temperature	
- that the thermometer can be delineated in different degree amounts.	- read and record temperatures on thermometers which are marked off on every degree every two degrees or every five degrees with accuracy.
Linear	
- the terms mile and rod, or kilometer and decimeter and their equivalencies.	- recite or list mile and rod or kilometer and decimeter equivalencies.
Weight	
- that any weight over 16 ounces can be renamed in ounces and pounds.	- be able to convert any number of ounces to pounds and ounces.
- the equivalencies of tons to pounds and grams and kilograms (etc.).	- be able to make correct conversions of pounds to tons and/or grams and kilograms.

Time	**Grade 5**
- the concept of time zones and the names and locations of those within the United States.	- identify the U.S. time zones on a map.
- the method for solving problems of time change.	- solve correctly word problems involving time changes.
Linear	
- that speedometers measure speed in miles per hour and odometers measure distance traveled.	- read, solve and create problems involving speedometers and odometers.
Temperature	**Grade 6**
- the number of Centigrade units in 5/9 as great as the number of Farenheit units.	- convert Centigrade to Fahrenheit temperatures and vice versa using formulas.
Linear	
- the equivalent measures, square foot, square yards, acres, square rods, square miles. (sq. meters or kilometers).	- solve problems using these conversions.
- the perimeter is the sum of the measures of the sides of a polygon ($p = 2(l+w)$ $p = 4s$).	- find the perimeter of square, rectangle, triangle, using the formulas.
- the circumference is the perimeter of a circle. $c = \pi d = \pi 2r$).	- find the circumference of a circle using the formulas.
- the area is the measure of the interior of a plane figure, $A = lw$, $A = \frac{1}{2} wb$, $A = \pi r2$.	- find the area of plane closed figures using the formulas.
- the volume is the measure of the interior of a solid figure. $V = lwh$.	- find the volume of rectangle solids.

- the English system:
  Linear Measure - inch; foot; yard; rod; mile.
  Liquid Measure - pint; quart; gallon; barrel
  Weights - grain; ounce; pound; ton.

- the metric system:
  Linear Measure - millimeter; centimeter; meter; kilometer
  Liquid Measure - milliliter; centiliter; liter; kiloliter
  Weights - milligram; centigram; gram; kilogram.

- the smaller the unit of measure, the greater is the precision.

- the greatest possible error of a measurement is equivalent to one-half the unit of measure being used.

- that relative error equals the greatest possible error divided by the unit of measure.
  Relative Error = $\frac{\text{Measure of Greatest Possible Error}}{\text{Measure}}$

Grades 7-8

- convert from a given unit of measure to an equivalent.
  Example 1 - 2 miles = _____ yards
  Example 2 - 3 gallons = _____ quarts
  Example 3 - 2 tons = _____ ounces.

Grade 8

- convert from a given unit of measure to an equivalent.
  Example 1 - 3 meters= _____ yards
  Example 2 - 500 milliliters = _____ centiliters
  Example 3 - 2 kilograms = _____ grams.

- recognize from a group of five measurements the most precise.
  Example: determine the most precise unit of measure from the following:
  ounce; milligram; gram; grain; pound.

- calculate the greatest possible error of a given measurements.
  Example: what is the greatest possible error of $3\frac{1}{2}$ in.? of 3 3/4 in.?
  Answers: $\frac{1}{4}$ in.; 1/8 in.

- the students will demonstrate the computational skills derived from the concepts of unit of measure and greatest possible error.
  Example: given measurement is 9 in. and the greatest possible error is .5 in., determine the relative error.

  $\frac{.5}{9} = .0555$ or 5.56%

Grade 8

- that before adding measures, or subtracting measures, express all the measurements with the precision of the least precise measurement.

- express measures with the precision of the least precise measurement.
  Example: express 74.923 and 28.49 with the precision of the least precise measurement.
  Answer: 74.92; 28.49.

- that when finding the quotient or product of two numbers, one being a measure and the other not, use the rule for addition of measures.

- apply the same rule for adding measures.
  Example: find the circumference of a circle if the diameter is 27 cm. ($\pi = 3.14$)

  $C = \pi D$

  $C = 3.14 \times 27$

  3.14 - 3 significant digits
  x 27 - 2 significant digits
  84.78 - round this to 2 significant digits
  85 - use this result.

Grade 9

Measurement

- the basic units of linear measurement in the English system and metric system.

- measure lines and objects with a ruler, yardstick, and meterstick.

- how to find unknown lengths using indirect

- identify corresponding sides of similar traingles, and using a ratio of the corresponding sides will find an unknown length.

- the trigonometric functions of right triangles.

- given a right traingle, a student will be able to identify the sine, cosine or tangent ratio of an angle of that traingle.

- to use the trigonometric tables (with no interpolation.)

- given an angle, the student will use this trig table to find the sine, cosine and tangent ratio of that angle as a decimal.

Grade 9

- given the sine, cosine or tangent ratio of an angle in decimal form, the student will find the measure of that angle.

Grade 10

Measurement

- the theorems involving the area of polygons.
  - calculate the area of a given polygon.
- the theorems involving measurements of angles of polygons.
  - be able to solve for the measures of the interior and exterior angles of a given polygon.
- the basic formula and definitions involved in coordinate geometry.
  - be able to find the distance between two points.
  - be able to find the midpoint of a line segment.
  - be able to find the slope of a line.
  - be able to write the equation of a line parallel or perpendicular to another line.
- the basic theorems involving angle measurement in circles.
  - find the measure of angles, and arcs given various facts involving the circle.
- the theorems regarding inequality in one triangle or two triangles.
  - present a proof showing one side greater than another side, or one angle greater than another angle in a given triangle or two triangles.
- the theorems involving angle sum.
  - find the measure of a required angle given numerical expressions involving angles and sides of polygons.

Grade 10 - 12

- the techniques of model construction
  - construct geometric models
- the metric system
  - calculate in the metric system
  - convert from Englis system to metric system
  - convert from metric system to english system.

Measurement	Grade 11
- the definitions of relation, domain, range, function and inverse of a relation.	- apply these definitions to a given equation and/or a given inequality. - determine if relation is a function.
- the definitions of a linear function and quadratic function.	- graph linear function. - graph quadratic function. - determine if two linear equations are parallel, perpendicular or intersecting.
- the quadratic function.	- graph the quadratic function - determine the axis of symmetry. - determine the solution set.
- the definition of logarithmic function.	- graph the logarithmic function.
- the characteristic of the six trigonmetric functions.	- graph each trigonometric function.
- the definitions of the accuracy and precision of a measurement.	- give in scientific notation, the weight of a sample of uranium precise to the nearest ten-thousandth of a gram - compute the relative error as a per cent accurate to two significant digits.
- the common unit of angle measure which is a degree.	- locate the [illegible] wing a position angle with a stated measure.
- the radian measures of different agnles.	- convert radian measure to degrees and degrees to radians.
	Grade 11 - 12
- the techniques used to calculate the mean, the median, and the mode using the data collected.	- use the data collected to calculate the mean, the median and the mode.
- the techinques used to calculate the mean and the standard deviation using the Monroe Calculator.	- use the data collected to calculate the mean and the standard deviation using the Monroe Calculator.

	Grade 11 - 12
- the techniques of finding 95% confidence interval for the true mean of a population.	- find a 95% confidence interval for the true mean of a population.
Measurement	Grade 12
- the techniques of preparing graphs that represent a pictorial approach to a specific conic section.	- utilize output data from the computer that results from solving a problem relating to a specific conic section.
- the application of knowledge of coordinate systems to graphing conic sections. (Special emphasis here is to eliminate the tedious plotting points method employed in earlier levels of instruction).	- interpret output data from a computer print-out and correlate it properly in units that results in an accurate graph of the conic section represented.
	- investigate to a limited amount relations between metric and English systems in measurement systems used in graphs.
- the techniques needed to find the area between two curves.	- find the area between two curves.
- the techniques needed to find the volume of a solid of revolution by the disc, shell and washer methods.	- find the volume of a solid of revolution by the disc, shell, and washer methods
- the techniques needed to find the area under a curve by the rectangular and trapezoidal approximation.	- find the area under a curve by the rectangular and trapezoidal approximations.
- the methods needed to find minimum and maximum areas and volumes by using derivatives.	- find minimum and maximum areas and volumes using derivatives.
- the formulae: area of a circle; surface area of a cylinder; surface area of a sphere; area of parallelogram, triangle, square, rectangle, trapezoid; surface area of a rectangular parallelepiped; volume of cylinder, cone, rectangular solid.	- evaluate the formulae: area of a circle; surface area of a cylinder; surface area of a sphere; area of parallelogram, triangle, square, rectangle, trapezoid; surface area of a rectangular parallelpiped; volume of a cylinder, cone, rectangular solid.