



Mathematics, Science & Technology

PART I.3

Scope and Sequence2

NOTE: This document is a work in progress. Parts II and III, in particular, are in need of further development, and we invite the submission of additional learning experiences and local performance tasks for these sections. Inquiries regarding submission of materials should be directed to: The Mathematics, Science, and Technology Resource Guide, Room 681 EBA, New York State Education Department, Albany, NY 12234 (tel. 518-474-5922).



<http://www.nysed.gov>

Hunter College Elementary School Planning Documents



Hunter College Elementary School is one of the oldest self-contained elementary schools for the intellectually gifted in the nation. It is a coeducational laboratory school which serves as a research and demonstration center. Excerpts from their planning documents show two ways to lay out expectations for students.

The Science excerpt, related to standard 1, scientific inquiry and mathematical analysis, shows age appropriate introductions of various inquiry skills. The Mathematics excerpt, related to measurement, performance indicator 5 of standard 3, delineates measurement concepts and skills. It describes at which grade level each skill should be introduced and points out that children need continued practice to achieve mastery as they move through elementary school.

MATHEMATICS Measurement: Length and Area

CONCEPTS AND SKILLS

The student will:

1. compare directly concrete objects to determine which is longer and which is shorter
2. measure objects using non-standard units
3. understand the need for a standard unit
4. use the meter stick to measure meters or centimeters
5. combine meters and centimeters when measuring
6. use feet, inches, and yards in measuring; include fractional parts
7. use equivalent measures in both metric and English measurement
8. use non-standard units to measure the distance around an object (perimeter)
9. use standard units to measure the distance around objects
10. develop an algorithm for finding the perimeter of regular shapes

INTRODUCE	PRACTICE	EXTEND/MASTER
N	K	1
K	1	2
1	1-2	2
1	2	3
2	3-5	6
K-1	2-4	5-6
2	3-5	6
K-1	2-3	4
1	2-4	5
2-3	4-5	6

Source: Hunter College Elementary School, New York City.

SCIENCE

PLANNING	N	K	1	2	3	4	5	6
Communicating Information	1	E	E	E	E	E	E	E
Predicting		1	E	E	E	E	E	E
Creating Models			1	E	E	E	E	E
Formulating Hypotheses				1	E	E	E	E
Recording Data					1	E	E	E
Questioning					1	E	E	E
Using Cues								1
Manipulating Ideas								1

OBTAINING DATA	N	K	1	2	3	4	5	6
Aquiring Information	1	E	E	E	E	E	E	E
Developing Vocabulary	1	E	E	E	E	E	E	E
Observing	1	E	E	E	E	E	E	E
Using Numbers		1	E	E	E	E	E	E
Measuring		1	E	E	E	E	E	E
Recording Data			1	E	E	E	E	E
Manipulating Materials			1	E	E	E	E	E
Using Clues			1	E	E	E	E	E

ORGANIZING DATA	N	K	1	2	3	4	5	6
Classifying	1	E	E	E	E	E	E	E
Communicating Information	1	E	E	E	E	E	E	E
Creating Models		1	E	E	E	E	E	E
Using Numbers			1	E	E	E	E	E
Manipulating Materials			1	E	E	E	E	E
Manipulating Ideas			1	E	E	E	E	E
Manipulating Ideas					1	E	E	E
Replicating								

Key

I = Skill introduced during the school year by conducting a lesson specifically on this skill

E = Skill extended with students during the school year

Planning Curriculum to Address Mathematics, Science, and Technology Standard 3 for Kindergarten Students



Ten area school districts in the Franklin-Essex-Hamilton BOCES have banded together in a regional effort to plan curriculum to match the new standards. These schools decided to begin at the early elementary level and continue on to all grade levels. Primary teachers representing all ten component districts of the Franklin-Essex-Hamilton BOCES met to develop higher standards in English language arts and mathematics, science, and technology.

The following standard 3 at the elementary (Kindergarten) level.

[STANDARD 3-Students will understand mathematics and become mathematically confident by communicating and reasoning mathematically, by applying mathematics in real-world settings, and by solving problems through the integrated study of number systems, geometry, algebra, data analysis, probability, and trigonometry.]

<p>Mathematical reasoning Students use mathematical reasoning to analyze mathematical situations, make conjectures, gather evidence, and construct an argument</p> <p><i>Students:</i></p> <p>use models, facts, and relationships to draw conclusions about mathematics and explain their thinking</p> <p>use patterns and relationships to draw conclusions about mathematics and explain their thinking</p> <p>justify their answers and solution processes</p>	<p>Data gathering (charts, graphs, tables, and tallying)</p> <p>Patterning/sequencing</p> <p>Problem-solving</p> <p>Recognize that ten is the same quantity, whether it refers to ten shapes or ten apples</p>	<p>Count, sort, and graph objects (i.e., color, size, and shape)</p> <p>Given teacher-made pattern of students, identify pattern, and continue it</p> <p>Create a pattern using unifix cubes</p> <p>Sequencing time-read <i>The Very Hungry Caterpillar</i> and sequence the fruit the caterpillar ate during the week; act out the story</p> <p>Given ten buttons, each child will sort them into two groups and explain why the buttons belong in the groups (big/small, rough, smooth, etc.)</p> <p>Demonstrate the quantity of ten by counting a variety of objects and matching</p>
--	--	--

Source: Jacanski, Carol. Franklin-Essex-Hamilton BOCES.

<p>Numbers and Numeration:</p> <p><i>Students;</i></p> <p>use number sense and numeration to develop an understanding of the multiple uses of numbers in the real world, the use of numbers to communicate mathematically, and the use of numbers in the development of mathematical ideas</p> <p><i>Students:</i></p> <p>use whole numbers and fractions to identify locations, quantify groups of objects, and measure distances</p> <p>use concrete materials to model numbers and number relationships for whole numbers and common fractions, including decimal fractions</p> <p>relate counting to grouping and to place value</p>	<p>Count by ones to 50</p> <p>Introduce counting by fives and tens</p> <p>Use concrete materials to model numbers and number relationships and common fractions</p> <p>Compare numbers to 10</p>	<p>Verbally count by ones to 50</p> <p>Write by ones to 20</p> <p>Use manipulatives to count number of notes played on a xylophone</p> <p>Use manipulatives to show greater than, less than, equal to, and solve simple stories</p> <p>Given groups of objects, discuss more than and equal to</p>
--	--	--

Vertical Articulation Science Model for Use With Elementary Students



ELEMENTARY

Science

The Port Washington Union Free School District teachers and administrators have developed a science concepts and skills model that aligns with mathematics, science, and technology standard 4.

During the 1995-96 school year, all teachers and administrators in the Port Washington School District met to identify core curriculum, concepts, and skills by subject and grade level. The following excerpt shows their plans for vertical articulation.

Pre-K – 2

EARTH SCIENCES

CONCEPTS

- Understanding that the earth is made up of land and water areas
- Understanding that the earth changes as a result of natural causes
- Understanding that the earth changes as a result of human behavior

CONTENT

- Seasonal changes
- Air and weather
- Caring for the environment
- Solar system
- Physical properties of rocks
- Beach studies

LIFE SCIENCES

CONCEPTS

- Understanding that living things change and grow
- Understanding that living things have basic needs
- Understanding that living things reproduce the same kind of living things
- Understanding that plants and animals are dependent on one another

Source: Port Washington Union Free Schools.

CONTENT

- Growth and change in the plant kingdom
- Needs of plants
- Growth and change in the animal kingdom
- Needs of animals
- Animal babies and their parents
- Interdependence of plants and animals
- Living healthy: nutrition, exercise, and emotional health

PHYSICAL SCIENCES

CONCEPTS

- Understanding that matter has forms and properties
- Understanding that physical changes occur in matter
- Understanding that chemical changes occur in matter
- Understanding that energy has forms and properties
- Understanding that matter and energy interact

CONTENT

- Simple machines
- Light
- Sound
- Electricity
- Properties of matter (powders and crystals)

CONCEPTS

Understanding that the earth changes as a result of natural causes

Understanding that the earth changes as a result of human behavior

CONTENT

Ecosystems

Oceanography

Conservation of natural resources

Rocks and minerals

Astronomy

Meteorology

Terrestrial bioforms

LIFE SCIENCES**CONCEPTS**

Understanding that living things change and grow

Understanding that living things have basic needs

Understanding that living things reproduce

Understanding that plants and animals are interdependent

CONTENT

Plant life cycles

Animal life cycles

Environmental adaptations

Food chains/food webs

Body systems

Issues of healthy living: nutrition, alcohol, tobacco, drug abuse, and AIDS, heredity

PHYSICAL SCIENCES**CONCEPTS**

Understanding that matter has forms and properties

Understanding that physical changes occur in matter

Understanding that chemical changes occur in matter

Understanding that energy has forms and properties

Understanding that matter and energy interact

CONTENT

Simple machines

Light

Sound

Electricity

Properties of matter (powders and crystals)

Elementary Mathematics Scope and Sequence



The Schenectady City Schools have developed a scope and sequence for elementary mathematics that aligns with mathematics, science, and technology standard 3.

Philosophy of Mathematics Curriculum

The Schenectady City School District recognizes that the understanding of mathematics is necessary for students to compete in today's technological society. A developmentally appropriate mathematics curriculum will incorporate a strong conceptual knowledge of mathematics through the use of concrete experiences. To assist students in the understanding and application of mathematical concepts, the mathematics curriculum will provide learning experiences which promote communication, reasoning, and problem solving skills. Students will be better able to develop an understanding for the power of mathematics in our world today.

Elementary School Mathematics Curriculum - Grades K-5

Goals and Objectives

Major Curriculum Strands:

1. Number and numeration
2. Operations with whole numbers
3. Operations with fractions and decimals
4. Probability and statistics
5. Geometry and measurement

The strands are interrelated, with each topic supporting and enhancing many others. The best lessons are those which integrate topics from other strands and other areas of the curriculum. Problem solving is a basic approach to the program which is utilized in every stand. Measurement involves practical experiences similar to those encountered in daily life situations. Basic mathematical skills will be applied in problem solving experiences. Computers and calculators are valuable tools which may be used in developing concepts, finding patterns, and checking work.

Student goals:

1. As a foundation each student will:
 - a. think logically and creatively
 - b. apply reasoning skills to solve problems
 - c. perform mathematical calculations
 - d. determine what information is necessary in a particular situation
 - e. acquire, organize, and use information in solving a problem
 - f. master computational skills.

Source: Schenectady City Schools.

2. Each student will learn methods of inquiry, reasoning, and knowledge through mathematics and use the methods and knowledge in interdisciplinary applications.
3. Each student will learn that mathematics can be used as a problem-solving tool in other areas of the curriculum and in every day problems outside of school.

I. NUMBER AND NUMERATION

- A. Conservation of number
- B. Counting (cardinal and ordinal)
- C. Place value
- D. Rounding/estimating
- E. Even and odd numbers
- F. Prime numbers
- G. Integers (positive and negative)
- H. Comparing numbers
- I. Number Patterns.

II. OPERATIONS WITH WHOLE NUMBERS AND INTEGERS

- A. Addition and subtraction of whole numbers
- B. Multiplication and division of whole numbers
- C. Interrelatedness of operations
- D. Factors/multiples.

III. FRACTIONS AND DECIMALS

- A. Concept of fractions and decimals
- B. Comparison of fractions and decimals
- C. Addition and subtraction of fractions and decimals
- D. Multiplication and division of fractions and decimals
- E. Percent
- F. Ratio and proportion.

IV. PROBABILITY AND STATISTICS

- A. Collect data (information)
- B. Organize and classify data
- C. Compare and analyze data
- D. Make predictions
- E. Arrangements and combinations.

V. GEOMETRY AND MEASUREMENT

- A. Length, distance, mass, capacity, time, temperature, and money
- B. Perimeter, area, and volume
- C. Shapes
- D. Symmetry, similarity, and congruence
- E. Coordinates.

I. NUMBER AND NUMERATION

- A. Conservation of number
 1. develop the idea that if two groups of objects can be matched in a one-to-one correspondence, they have the same cardinal number
 2. develop an awareness of concepts, words, and symbols related to numbers in daily living
- B. Counting (cardinal and ordinal numbers)
 1. develop the concept that the last number counted in a group of objects tells how many things are in the group (cardinal number)
 2. identify number names orally through 15, read and write numerals 0-10, and count forward and backward
 3. develop the concepts of first, middle, and last
 4. use ordinal numbers names from 1st through 10th
- C. Compare sets of objects using terms: more than, bigger than, less than, one more than, the same size, equal to, before, after, and between.

II. OPERATIONS WITH WHOLE NUMBERS AND INTEGERS

- A. Addition and subtraction of whole numbers
 1. combine simple sets to produce new sets
 2. explore the idea of “one more”
- B. Share sets of objects such as cookies or crayons (multiplication and division).

III. FRACTIONS AND DECIMALS

- A. Awareness of fractions and decimals in daily life(money)
- B. Concept of *half*.

IV. PROBABILITY AND STATISTICS

- A. Organize and classify data
 1. categorize objects using attributes such as likeness and differences in color, shape, and size
 2. simple bar graphs using stacks of blocks
- B. Observe likenesses and differences using two categories at a time; concepts of *more, less, and the same*
- C. Discuss certainty and uncertainty of events; terms *more and less likely*; anticipate outcomes by guessing and estimation.

V. GEOMETRY AND MEASUREMENT

- A. Compare dimensions of various objects using terms like *larger than, taller than, smaller than, shorter than, as long as, farther, or nearer*; measure objects using non-standard units
- B. Compare capacity of containers using sand and water
- C. Compare temperatures and durations of time
- D. Weighing experiences using terms *heavier than and lighter than*
- E. Practice the estimation of ske
- F. Observe objects in the environment that have geometric shapes; make geometric pictures, patterns, and designs using geometric shapes.

I. NUMBER AND NUMERATION

- A. Counting
 1. count forward and backward by ones and twos on a number line
 2. count to 100 on a number line
 3. whole number immediately before and after a given number; between whole numbers
 4. match words and symbols from 0 to 15
 5. use tallies to record the size of a group of objects
- B. Place Value
 1. study the meaning of each digit in two digit numbers
 2. use expanded notation to represent a two digit number ($17 = 10 + 7$)
- C. Estimate quantity and grouping by using manipulatives
- D. Introduce the concept of odd and even numbers
- E. Introduce the symbols =, <, >
- F. Investigate patterns for sum and differences using concrete models.

II. OPERATIONS WITH WHOLE NUMBERS

- A. Addition and subtraction
 1. use models to develop the terms *larger than*, *smaller than*, and *equivalent to*
 2. introduce the special role of zero in addition and subtraction
 3. practice the addition of sums through 10; subtraction facts through 10
 4. add three numbers, sum less than or equal to 10
 5. add and subtract 2 digit numbers with no regrouping/trading
 6. develop the concept that the order in which addends are written does not change the answer(commutative property of addition).

III. FRACTIONS AND DECIMALS

- A. Develop the concept of unit fractions($1/2$, $1/3$, $1/4$)
- B. Develop the concept of oneness ($2/2 = 3/3 = 4/4 = 1$)
- C. Explore many to one in preparation for the study of ratio (5 fingers to 1 hand)
- D. Continue to use money notation to practice decimals.

IV. PROBABILITY AND STATISTICS

- A. Collect data, record results with tallies, blocks, pictographs, etc.
- B. Practice predicting outcomes by tossing coins, paper cups, or dice
- C. Solve problems such as *how many different pairs of numbers add to 10?*

V. GEOMETRY AND MEASUREMENT

- A. Study time to the hour, day, month, and year using clocks and calendars
- B. Investigate how to make change for amounts of money
- C. Use meter, centimeter, and decimeter for measuring length
- D. Introduce kilogram, liter, and Celsius thermometer
- E. Identify shapes in everyday life: *square, rectangle, triangle, and circle*
- F. Continue to measure objects using non-standard units.

Grade 1

I. NUMBER AND NUMERATION

- A. Counting
 - 1. use ordinal numbers to 31st
 - 2. count to 1,000
 - 3. count by 2's, 3's, 4's, 5's, 10's using a number line and number charts
- B. Place value
 - 1. represent 2 and 3 digit numbers to 999 using concrete models
 - 2. study the meaning of zero in the place value system
 - 3. two and three digit numbers in expanded notation ($325 = 300 + 20 + 5$)
- C. Rounding off numbers using a number line.

II. OPERATIONS WITH WHOLE NUMBERS

- A. Addition and subtraction
 - 1. master addition and subtraction facts (sums through 18)
 - 2. add and subtract 2 digit numbers which require regrouping
 - 3. explore inequality in number sentences ($2+1<4$)
 - 4. explore different groupings when adding three or more numbers (associative property)
 - 5. show that addition and subtraction are inverse operations
- B. Multiplication and division
 - 1. explore multiplication and division through sharing sets or groups
 - 2. show that the order of factors in a multiplication problem does not change the answer
 - 3. relate multiplication to be repeated additions ($3 \times 5 = 5 + 5 + 5$)
 - 4. show that multiplication and division are inverse operations
- C. Practice estimation of answers with and without story problems.

III. FRACTIONS

- A. Relate unit fractions to *one whole*
- B. Unit fractions to $1/8$, $1/10$, and $1/100$
- C. Locate halves on a number line or ruler
- D. Find $1/2$, $1/3$, and $1/4$ of a collection
- E. Explore two-to-one correspondence to expand the concept of ratio
- F. Explore addition and subtraction using money notation (2 place decimals).

IV. PROBABILITY AND STATISTICS

- A. Collect and tabulate data using measurement of common items
- B. Arrange data in tables and illustrate with graphs
- C. Compare data in terms of number, equality, inequality, similarities, and differences
- D. Perform experiments with three or more equally likely outcomes
- E. Make predictions of outcomes and explain
- F. Combinations and arrangements (How many different groups of 3 numbers will add to 12?)
- G. Investigate beginning logic concepts.

V. GEOMETRY AND MEASUREMENT

- A. Weigh objects using grams, kilograms
- B. Measure time in half hours, quarter hours, and 5 minutes intervals
- C. Make change of amounts of money up to \$1.00
- D. Measure liquids in liters, milliliters
- E. Practice addition of measures
- F. Use shapes to create designs
- G. Observe two and three dimensional objects in every day experience
- H. Introduce English units of measure
- I. Measure using meters, centimeters, and kilometers
- J. Continue to measure using non-standard units
- K. Estimate using actual units of measure.

Grade 2

I. NUMBER AND NUMERATION

- A. Counting
 - 1. Count cardinal numbers through 100,000
 - 2. Ordinal numbers through 500
 - 3. Count to 100 by 2's, 3's, 4's, 5's, and 10's
- B. Place value
 - 1. Use activities with money to explore place value to the right of the decimal point
 - 2. Use and read numbers through 100,000
- C. Rounding
 - 1. Round numbers using the number line and measuring instruments (thermometer, meter stick, and yard stick)
- D. Predict when sums will be odd or even
- E. Introduce the concept of positive and negative numbers.

II. OPERATIONS WITH WHOLE NUMBERS

- A. Addition and subtraction of whole numbers
 - 1. Master addition and subtraction facts with sums through 25
 - 2. Add 2, 3, and 4 digit numbers with sums less than 10,000
 - 3. Subtract two numbers each less than 10,000
- B. Multiplication and division
 - 1. Explore the special role of 0 and 1 in multiplication
 - 2. Experiment with grouping 2 or more factors (associative law)
 - 3. Work with multiplication and division (products through 100)
 - 4. Study short and long algorithms for division
 - 5. Develop the concept that the order in which factors are written does not change the product (commutative property)
 - 6. Explore division as finding the number of equal groups of items
 - 7. Emphasize multiplication and division being inverse operations
- C. Concepts of equality and inequality in problems involving all four operations.

Grade 3

III. FRACTIONS AND DECIMALS

- A. Order unit fractions using $<$ and $>$ symbols
- B. Review the concept of $1 = 2/2 = 3/3 = 4/4 =$ etc.
- C. Use terms “numerator and denominator”
- D. Develop the concept of equivalent fractions and decimals ($1/2 = .5$, $1/4 = .25$, and $3/4 = .75$)
- E. Add and subtract fractions with like denominators
- F. Add and subtract decimals with one place (tenths)
- G. Continue to use concrete problems to explore the meaning of ratio.

IV. PROBABILITY AND STATISTICS

- A. Organize data using tables and bar graphs
- B. Discuss graphs found in everyday publications
- C. Conduct experiments and predict outcomes
- D. Use fractional notation to express the probability of the outcome of an experiment
- E. Use orderly methods, like tree diagrams, to count the number of outcomes in an experiment
- F. Continue to introduce beginning logic concepts.

V. GEOMETRY AND MEASUREMENT

- A. Identify equivalent measures within a measuring system(1,00 centimeters = 1 meter; 12 inches = 1 foot)
- B. Relate the clock to circle construction and fractions
- C. Find the perimeter of polygons
- D. Investigate the properties of plane figures including diameter and radius of a circle
- E. Construct plane figures(polygons and circles)
- F. Explore 3 dimensional figure to begin the understanding of volume (taking up space)
- G. Learn how to use a compass and protractor
- H. Continue to investigate symmetry(reflections)
 - 1. Locate points in a plane using a grid
- J. Investigate properties of solid figures.

Grade 3

I. NUMBER AND NUMERATION

- A. Counting
 - 1. Read and write whole numbers to hundred millions
 - 2. Skip count to numbers greater than 100
- B. Extend place value to concepts to millions and hundredths
- C. Round numbers to the nearest whole number, ten, hundred, and thousand
- D. Predict when the product of two numbers will be odd or even
- E. Continue the discussion of positive and negative numbers with applications in daily life
- F. Look for patterns in sequences of numbers; write the rules for a sequence.

II. OPERATIONS WITH WHOLE NUMBERS

- A. Addition and subtraction
 - 1. Add and subtract whole numbers, sums less than 1 million
 - 2. Subtract whole numbers when zero is in the minuend, renaming/trading if necessary
 - 3. Continue to estimate sums and differences prior to computation
 - 4. Find missing addends in an addition sentence ($23 + ? = 30$)
- B. Multiplication and division
 - 1. Multiplication and division; products through 144
 - 2. Introduce the concept of a “prime factor”
 - 3. Multiplication of three digit numbers by two digit numbers
 - 4. Multiplication by multiples of 10
 - 5. Find common factors of groups of numbers less than 100
 - 6. Begin the concept of least common factor and greatest common multiple
 - 7. Find the quotient and remainder when a three digit number is divided by a one digit number
 - 8. Use the inverse operations to check division by multiplication
- C. Investigate distributive property ($326 \times 4 = 300 \times 4 + 20 \times 4 + 6$).

III. FRACTIONS AND DECIMALS

- A. Study the order of unit fractions ($1/2 > 1/3 > 1/4$)
- B. Compare fractions on a number line
- C. Correlate the common fraction notation for decimals to the tenths place
- D. Addition and subtraction
 - 1. add and subtract fractions with unlike denominators
 - 2. add and subtract decimals to the hundredths place
- E. Multiplication and division
 - 1. multiply decimal to tenths
 - 2. practice locating decimal points in products
- F. Continue to develop the concept of ratio in every day problems.

Grade 4

IV. PROBABILITY AND STATISTICS

- A. Collect statistical data from newspapers, magazines, polls, and activities in other subject areas
- B. Make frequency tables from tallied data
- C. Use models, pictures, and tree diagrams to organize data
- D. When organizing data examine the range(difference between smallest and largest)
- E. Develop the concept *average* (arithmetic mean)
- F. Continue to investigate beginning logic concepts.

V. GEOMETRY AND MEASUREMENT

- A. Find the perimeter, area, and volume of specific figures, using appropriate units
- B. Use rulers, protractors, and compasses to construct plane geometric figures
- C. Use terms such as *polygon, circle, chord, radius, diameter, face edge, vertex, line segment, point parallel, and perpendicular*
- D. Extend work in coordinate geometry to both positive and negative coordinates.

I. NUMBER AND NUMERATION

- A. Read and write numbers to one billion
- B. Investigate powers of 10 to develop an understanding of exponents
- C. Express numbers in expanded notation using powers of 10 ($6425 = 6 \times 10^3 + 4 \times 10^2 + 2 \times 10 + 5$)
- D. Round off numbers to nearest 10,000; nearest hundredth
- E. Continue to use a number line as an aid in understanding negative numbers.

II. OPERATIONS WITH WHOLE NUMBERS

- A. Quick review of addition, subtraction, multiplication, and division facts
- B. Literal problems using single operation(stress integration with other subjects)
- C. Develop concept of order of operations
- D. Continue to find greatest common factor and least common multiple.

III. FRACTIONS AND DECIMALS

- A. Develop the concept of proper and improper fractions
- B. Continue addition and subtraction of fractions with like and unlike denominators
- C. Change improper fractions to mixed number
- D. Compare fractions and decimals using terms *less than, greater than, equivalent to, and between*
- E. Practice writing equivalent forms of decimals and fractions
- F. Addition and subtraction of decimals with hundredths and thousandths
- G. Multiply and divide (using whole number divisors) decimals to hundredths
- H. Multiply and divide decimals by powers of 10 (move decimal point to right or left)
- I. Round off decimals to thousandths
- J. Use pictures and/or graphic illustrations to demonstrate multiplication and division of fractions.

Grade 5

IV. PROBABILITY AND STATISTICS

- A. Continue to explore methods of collecting and organizing data
- B. Use tables, graphs, and diagrams to represent collected data
- C. Use compass and protractors to construct circle graphs
- D. Compare bar, line, and circle graphs which represent the same information
- E. Identify events which have probability =0, probability =1 (certainty); probability between 0 and 1
- F. Continue to investigate logic concepts.

V. GEOMETRY AND MEASUREMENT

- A. Be familiar with common metric units used in every day life; prefixes, *milli*, *centi*, *kilo*
- B. Continue to study perimeter, volume, and area using graph paper and manipulatives
- C. Develop formulas for the area and perimeter of squares and rectangles
- D. Measure the area and perimeter of rectangles, triangles, and irregular polygons using blocks, geoboards, graph paper, and other informal methods
- E. Continue to measure volume
- F. Continue to measure temperature using Celsius and Fahrenheit thermometers
- G. Continue to draw and measure plane figure using rulers, protractors, and compasses
- H. Use pictures to explore similar and congruent figures; symmetry.

5 Grade

New York State Standards for Mathematics, Science, and Technology

Grade

5

This fifth-grade scope document from the Utica City Schools details the connections to mathematics, science, and technology standard 7.

New York State mathematics, science, and technology standard 7-interdisciplinary problem solving: Students will apply the knowledge and thinking skills of mathematics, science, and technology to address real-life problems and make informed decisions.

Standards of Performance/Dimensions of Learning (Objectives)	Student Activities/Tasks	Assessment/Measurement (Descriptors and Rubrics)	Technology (Integration/Connections)
<p>CONNECTIONS <i>Students will show:</i></p> <p>1. that knowledge and skills of mathematics, science, and technology are used together to make informed decisions and solve problems, especially those relating to issues of science, technology/society, consumer decision making, design, and inquiry into phenomena.</p>	<p>Students:</p> <ul style="list-style-type: none"> analyze science/technology/society problems and issues that affect their home, school, or community, and carry out a remedial course of action make informed consumer decisions by applying knowledge about the attributes of particular products and make cost/benefit trade offs to arrive at an optimal choice design solutions to problems involving a familiar and real context, investigate related science concepts to inform the solution, and use mathematics to model, quantify, measure, and compute observe phenomena and evaluate them scientifically and mathematically by conducting a fair test of the effect of variables, and use mathematical knowledge and technological tools to collect analyze, and present data and conclusions. 	<p>Teacher Observation</p> <p>Connections Rubric</p> <p>Informal Inventory</p>	<p>Internet Web Browser; Research Software (CDs): Encarta, World Book Ency., Compton's Ency., Grolier's Ency., other subject specific CDs, etc.</p> <p>Desktop Publishing Software: Children's Writing and Publishing Center, Word, Works, TLC's Student Writing Center, First Choice, Story Book Weaver, etc.</p>
<p>STRATEGIES <i>Students will show:</i></p> <p>2. solving interdisciplinary problems involves a variety of skills and strategies, including effective work habits; gathering and processing information; generating and analyzing ideas; realizing ideas; making connections among the common themes of mathematics, science, and technology; and presenting results.</p>	<p>Students participate in an extended, culminating mathematics, science, and technology project. The project would require students to:</p> <ul style="list-style-type: none"> work effectively gather and process information generate and analyze ideas observe common themes realize ideas present results. 	<p>Teacher Observation</p> <p>Strategies Rubric</p> <p>Informal Inventory</p>	

Source: *Technology and Elementary Curriculum Integration Plan, Grade 5, Utica City Schools, 1996.*

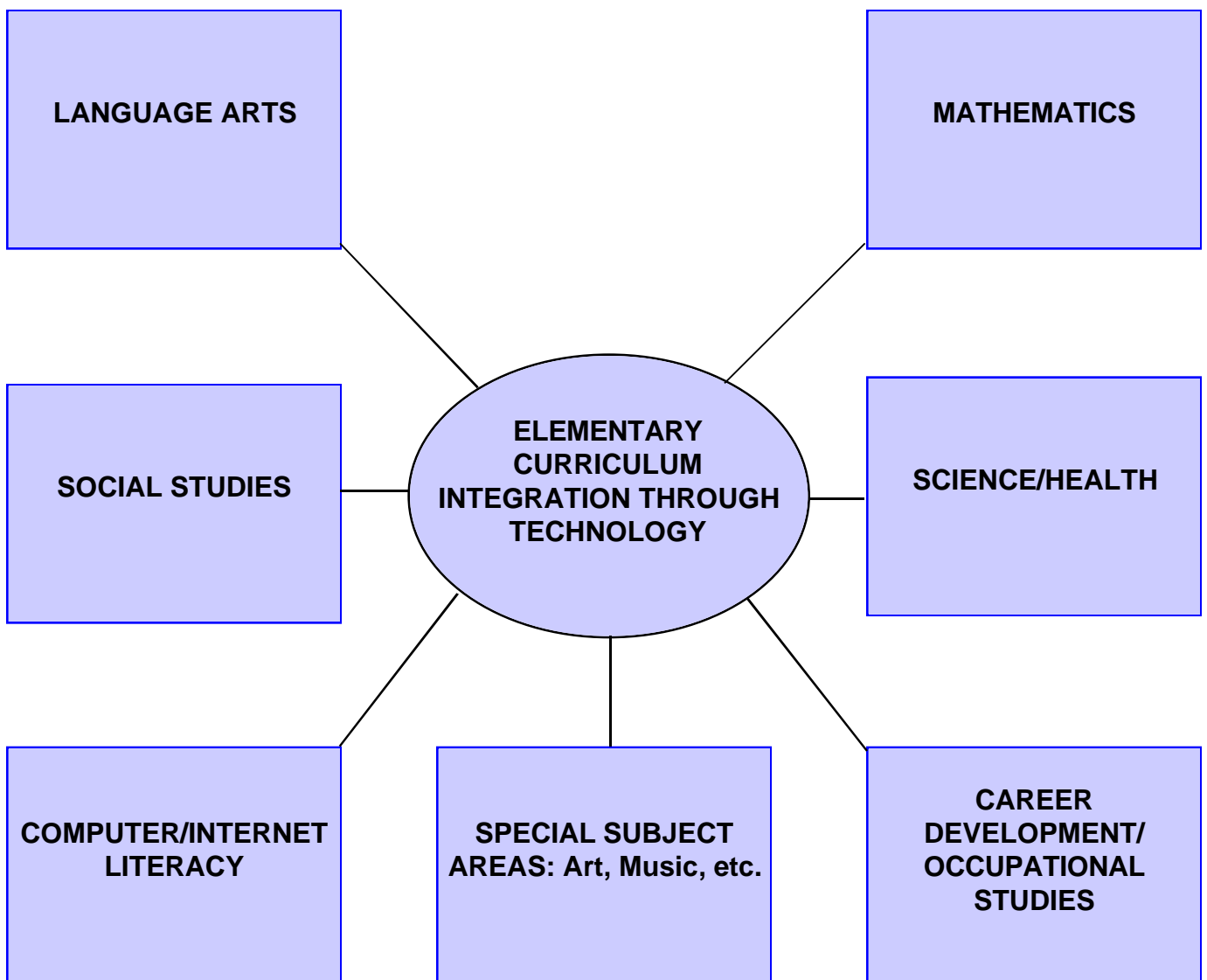
UTICA CITY SCHOOL DISTRICT

Technology and Elementary Curriculum Integration Plan

Promotes Magnet School Themes and Projects: Careers, Communications Technology, Computer Technology, Dance, Drama, Early Childhood Development, Literature, Multiculturalism, Mathematics and Science, Media Arts, Micro Society, Pathways to the Future, and the School to Work Program.

MISSION OF THE TECHNOLOGY AND ELEMENTARY CURRICULUM INTEGRATION TASK FORCE: In keeping with the Exit Standards for the Utica City School District, our mission is to empower students to become “technologically proficient learners” with the ability to “utilize technology as a communications tool, to access information, to analyze information, to prepare for career opportunities, to develop a career portfolio, and to understand the effects of technology on society.” Our goal is to prepare students to become knowledgeable, skillful participants in a technologically advanced society.

PLAN OUTLINE



Intermediate Mathematics Scope and Sequence



The Schenectady City Schools have developed a scope and sequence for intermediate mathematics that aligns with mathematics, science, and technology standard 3.

Philosophy of Mathematics Curriculum

The Schenectady City School District recognizes that the understanding of mathematics is necessary for students to compete in today's technological society. A developmentally appropriate mathematics curriculum will incorporate a strong conceptual knowledge of mathematics through the use of concrete experiences. To assist students in the understanding and application of mathematical concepts, the mathematics curriculum will provide learning experiences which promote communication, reasoning, and problem solving skills which will enable students to develop an understanding of the power of mathematics in our world today.

Grades 6-8

Goals and Objectives

The middle school mathematics curriculum is designed to improve the problem solving abilities of students while continuing a development of skills and concepts. Problem solving situations are an integral part of each of the strands of study:

1. number concepts
2. ratio, proportion, and percent
3. probability and statistics
4. algebra and coordinate geometry
5. geometry and measurement.

Problem solving is the basic approach to the program and is utilized in every strand. Integration of topics should occur naturally, not be forced. Although students must demonstrate competence in mathematical operations, computers and calculators are valuable tools which will be used in developing concepts, finding patterns, checking work, and removing some of the computational drudgery from problem solving experiences.

Goals for students include the following:

1. As a foundation each student will:
 - a. think logically and creatively
 - b. apply reasoning skills to issues and problems
 - c. perform mathematical calculations
 - d. determine what information is necessary in a particular situation
 - e. acquire, organize, and use information in solving a problem
 - f. master computational skills.
2. Each student will learn methods of inquiry, reasoning, and knowledge through mathematics and use the methods and knowledge in interdisciplinary applications.
3. Each student will learn that mathematics can be used as a problem solving tool in other areas of the curriculum and in every day problems outside of school.

Source: Schenectady City Schools.

NUMBER CONCEPTS

Concepts/Skills

Grade

read and write numbers through billions
continue to practice and improve operational skills (addition, subtraction, multiplication, and division)
practice finding least common multiple and greatest common factor
reinforce place value using expanded notation($3862 = 3 \times 1000 + 8 \times 100 + 6 \times 10 + 2$)
find succeeding terms in a presented sequence
round off whole numbers through 10 thousands
use of exponents up to 5
introduce the concept of negative integers
add, subtract, multiply, and divide fractions with common and non-common denominators, and mixed numbers
add, subtract, multiply, and divide decimals
compare fractions and decimals using concepts of less than, more than, and between equivalent forms of fractions, decimals, per cents ($1/2$'s, $1/3$'s, $1/4$'s, $1/5$'s, $1/8$'s, and $1/10$'s)

6

read and write numbers through trillions
find the missing term in a sequence and write the rule
round off whole numbers through hundred billions
reinforce place value by using the expanded form of a number using exponents
addition, subtraction, multiplication, and division of integers
introduce the concept of absolute value
identify elements for addition and multiplication
additive inverse
introduce the concept of perfect square numbers and their positive square root
terminating and repeating decimals
conversion of fractions, decimals, and percents (percents less than 100 percent)
express numbers in scientific notation (numbers greater than 1)

7

introduce the concept of zero as an exponent
comparison of integers including the concept of absolute value
find the missing term in a sequence with positive and negative integers and write the rule
positive and negative square root of a perfect square
estimate the square root of a non-perfect square number
compare positive and negative fractions and decimals using more than, less than, and between
conversion of fractions, decimals, and percents (percents greater than 100 percent and less than 1 percent)
express numbers in scientific notation (numbers less than 1)
introduce the concept of irrational numbers

8

RATIO, PROPORTION, PERCENT

Grade

Concepts/Skills

6

extend the use of fractional notation to ratios
understand the concept that 2 or more equivalent ratios form a proportion
find the missing term in a proportion where terms are whole numbers
use of circle graphs to understand percent
investigate intuitively the concept of similar polygons
construct scale drawings

7

find the missing term in a proportion where terms can be rational numbers and integers
define means and extremes
introduce the concept of rates (distance, time, and unit pricing, etc)
construct circle graphs to explain percent
find the percent of a number
find what percent one number is of another number
find a number when a percent of the number is known

8

introduce indirect measure in the study of similar polygons to find missing parts of geometric figures
percent of increase and percent of decrease

PROBABILITY AND STATISTICS

Grade

Concepts/Skills

6

use average (mean) to interpret data
collect data to describe an experiment
construct bar graphs and line graphs to demonstrate data collected
conduct and predict outcomes of experiments with independent events

7

mean, mode, and median
organize data using terms such as range, intervals, and frequency
identify sample spaces by listing all elements or tree diagrams

8

construct histograms
use frequency tables
introduce the counting principle to determine the number of outcomes
investigate compound probability with independent events

ALGEBRA AND COORDINATE GEOMETRY

Concepts/Skills	Grade
determine the order of operations develop the concept of a solution to an open sentence use an ordered pair to locate a point on a grid use ordered pairs to construct figures	6
find the solution to mathematical sentences using more than one step use algebra to translate verbal phrases into mathematical form (more than, less than; increase, decrease) evaluate algebraic expressions using integers as substitutions graph number pairs using integers in all four quadrants use line graphs to demonstrate the solution to inequalities	7
find the solution to mathematical sentences using more than one step use the distributive law in finding the solution to equations combine like algebraic terms to make a single term use algebra to translate verbal sentences to mathematical sentences use mathematical sentences to find the solutions of literal problems interpret tables to form equations write a mathematical sentence based on number pairs in a table and draw the straight line picture	8

GEOMETRY AND MEASUREMENT

Concepts/Skills	Grade
find the area and circumference of circles find the area and perimeter of polygons such as triangles, rectangles, and squares compute the volume of rectangular prisms identify and construct angles with protractor and compass (acute, right, obtuse, and straight) develop the concept of parallel and perpendicular lines	6
introduce geometric terms (point, line, plane, segment, and ray) name and define angles (acute, obtuse, right, straight, and reflex) discover and define angle pairs (vertical, supplementary, and complementary) construct and classify triangles by angles and sides construct and classify quadrilaterals (rectangle, square, parallelogram, and trapezoid) determine the formulas for area and circumference of a circle find the surface area of a rectangular prism determine the formula to find the volume of rectangular prism, cube, and cylinder determine the formula to find the area of triangles and quadrilaterals use parallel lines to determine specific angle pairs	7
find the volume and surface area of 3 dimensional solids introduce sphere, cone, pyramid, and triangular prism use compass and straight edge to bisect line segments and angles use compass and straight edge to construct parallel and perpendicular lines use compass and straight edge to construct triangles, rectangle, square, and regular hexagon use the Theorem of Pythagoras to discuss the relationship between the sides of a right triangle find the missing side of a right triangle use parallel lines and transversal to identify and measure resulting angle pairs	8



Teachers at Smithtown Middle School use this activity model to organize their technology curriculum to integrate with other subject areas, thereby illuminating standard 5.

The following is a brief outline of the activities covered, including the grade levels and other subject areas that the activities tie into.

SIXTH GRADE (TEN WEEK PROGRAM)

1. Bow saw (mathematics and technology development)
2. Center of gravity device (science and technology)
3. Noteholder (technology)
4. Resources of technology
5. Communications (computer)
6. Marine technology (mathematics, science, and technology)
7. Introductory electronics (science and technology)
8. Bridge construction (mathematics, science, and technology-problem solving)

SEVENTH GRADE (TWENTY WEEK PROGRAM)

1. Structures—straw tower (computer spread sheets, science, and technology)
2. Spinning top (mathematics, science, and technology)
3. Safety vehicle (mathematics, science, and technology)
4. Wind turbine (mathematics, science, and technology)
5. Catapult (history, mathematics, science, and technology)
6. Aerospace—an introduction to flight and rocketry (history, mathematics, science, and technology)
7. Electronics—simple control systems (mathematics, science, and technology)
8. Research project (library skills, English language arts)
9. Enrichment
 - Playground design—modeling (mathematics and technology)
 - Micro Baha vehicle (mathematics, science, and technology)
 - Yo-yo—flywheel on a string (science and technology)
 - Oral presentation (related to research project)

EIGHTH GRADE (TEN WEEK PROGRAM)

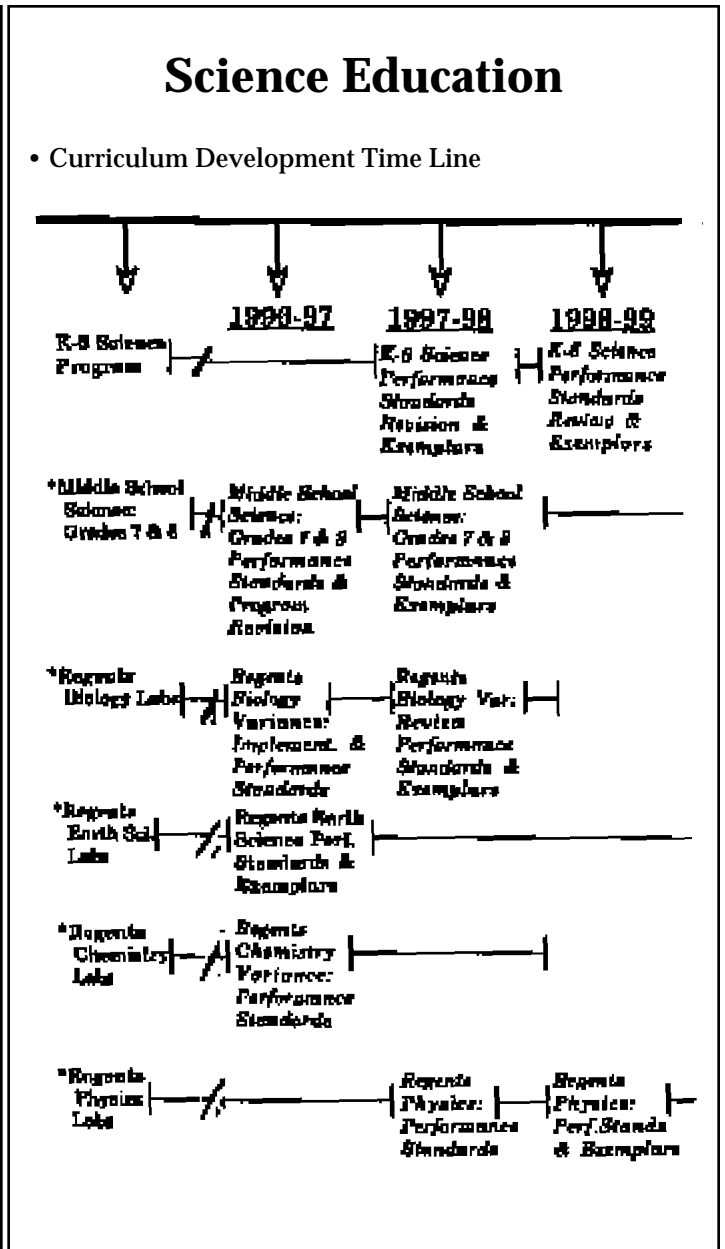
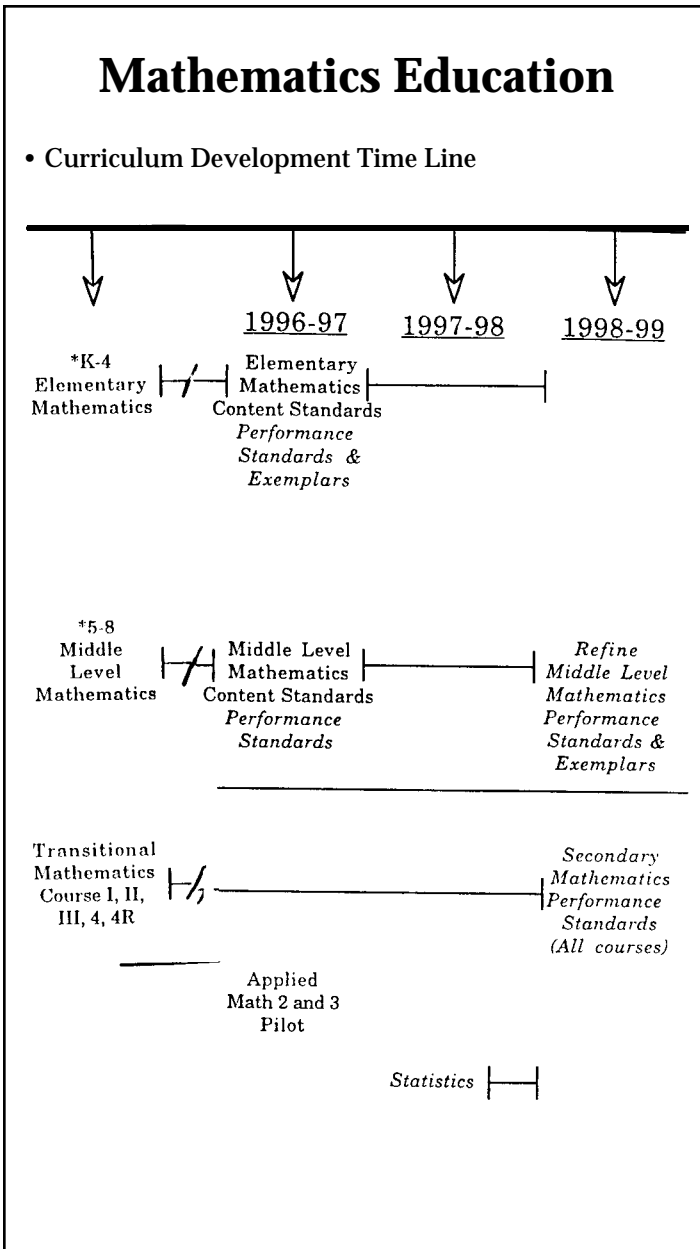
1. House of cards (mathematics, science, technology, and computers)
2. Electronics (mathematics, science, and technology)
3. Magnetic levitation (mathematics, science, and technology)
4. Save the world—should an asteroid threaten the Earth (mathematics, science, technology, and English language arts)
5. Compressed air vehicle (mathematics, science, and technology)
6. Enrichment
 - Manufacturing activity (processing resources)
 - Newsletter (communications)

Source: Ruiz, Ernest, *Technology Education*, Smithtown Middle School, Smithtown Central Schools.

Curriculum Development Time Line for Mathematics and Science



Williamsville Central Schools have planned their curriculum development for mathematics and science using a timeline as a tool for organizing their activities. This example is provided to demonstrate a chronological approach to aligning curriculum with the State standards.



Source: Williamsville Central School District.

Integrated Regents Program

MST

1 2 3
4 5 7

COMMENCEMENT

Integrated Approach

PROGRAM OVERVIEW

The program is an integrated approach to the teaching of math, science, business education, home economics, and technology education and is designed to encourage students to take four years of these subjects. It is targeted at those students who would normally take general level courses in math and science or who are experiencing difficulty in Regents level courses. Curriculum planning provides extended time for the mastery and application of mathematics and science topics so that students can achieve at a Regents level.

The first two years of the program are divided into four semester blocks generally as follows:

9th grade

10th Grade

first semester

mathematics (portions of 1R)
science (biology)

home economics or
technology

first semester

mathematics (portions of 1 R)
science (biology/earth science)

business or
technology

second semester

mathematics (portions of 1 R)
science (biology/earth science)
technology or
home economics

second semester

mathematics (finish 1R/portions of 2R)
science (earth science/physical science)
technology or
business

At the end of two years, students will earn 2 credits for mathematics, 2 credits for science, 1 credit for technology (.5 credits twice), .5 credit for business and .5 credit for home economics. Additionally, 1 unit of Regents credit for both math and science can be achieved by successfully passing the Regents examination in SM 1R and a modified science examination at the end of tenth grade. The Proficiency examination in introduction to occupations will also be administered at this time.

Continuation in the program during the junior and senior year will enable the student to achieve an additional 2 credits for mathematics, 2 credits for science, and 2 credits in either business, home economics or technology. Also, one unit of Regents credit for both math and science can be achieved at the end of the fourth year by successfully passing a Regents examination. A student will then need one additional outside credit in either business, home economics, or technology for a five unit sequence. A five unit sequence in art or music can be achieved through appropriate elective selection and independent study activities.

Source: Swinton, Dr. Steven. Science Supervisor, Shaker High School, North Colonie Central Schools.

A typical four year program would be:

Period/Grade	9th	10th	11th	12th
1	IRP	RP	IRP	IRP
2	IRP	IRP	IRP	IRP
3	IRP	IRP	IRP	IRP
4	ENGLISH	ENGLISH	ENGLISH	ENGLISH
5	SOCIAL	SOCIAL	SOCIAL	SOCIAL
6	PHYSICAL ED.	PHYSICAL ED.	PHYSICAL ED.	PHYSICAL ED.
7	ART/MUSIC	ELECTIVE	HEALTH/ELE	SEQ. ELECTIVE

IRP= Integrated Regents Program

Several Additional Points:

1. The program involves a **two-year commitment** from the student. Students who fail math or science at the end of one year must remediate the failure over the summer by attending summer school. Students who fail either the home economics or technology component may continue with the program, but will need another half credit during the last two years of high school.
2. It is a four-year program, however, students may leave or enter after two years. **Tenth-graders not new to the district will not be eligible for this program.** Therefore, students enrolled in SM 1R or Earth science R as ninth-graders will need to take SM 2R and biology R as 10th-graders to satisfy the two unit math/science requirement.
3. Students who leave the district at the end of the ninth grade will have earned:
 - a. one credit each for general mathematics and general science
 - b. half credit each for home economics and technology.
4. Movement into the program from the traditional Regents program in January of the ninth grade is possible but will be difficult and is probably not desirable. Movement could mandate summer school, resulting in credit loss or jeopardizing sequence eligibility. Questions concerning student placement should be answered as soon as possible, preferably by October 1 of the ninth grade, so that adjustments can be made in a timely fashion. Movement into the program in January of the 10th-grade is not possible.
5. For the rare student that leaves the program at the end of the ninth grade, he/she will have earned:
 - a. one credit each for general mathematics and general science
 - b. half credit each for home economics and technology. Therefore, this student can enroll in business mathematics or SM 1R and Earth science R or biology R.

Integrated Regents Program **Years 3 and 4**

Program Overview

The program will continue to be integrated and have a hands-on focus. As in the first two years, students will be best served if they make a two-year commitment to the program. It will rely on the same team teaching structure as years 1 and 2. Continuation in years 3 and 4 of the program will enable the student to achieve an additional 2 credits in mathematics, 2 credits in science, and 2 credits in either business education, home economics, or technology education. Students will select only 1 of the occupational education areas (technology, home economics, or business) to focus on during these last two years. One unit of Regents credit for both mathematics and science can also be achieved by passing a Regents exam (locally developed) in January of year 4 and by completing a guided interdisciplinary problem-solving activity in the final semester of the program. The student will also need to complete an additional unit in occupational education (business education, home economics, or technology education) **outside of the program** in order to meet a five unit sequence requirement.

Overview of Program Components (Thematic Approach)

Mathematics

The mathematics component of the program will include the topics of:

- Advanced algebra
- Trigonometry
- Statistics and probability
- Computer programming

Science

The science component of the program will include the topics of:

- Energy
- Chemical bonding
- Dynamics
- Waste management
- Greenhouse effect

Note: Students will select one of the following occupational education areas.

Business Education

The Business Education component of the program will include the topics of:

- Information processing (desktop publishing, graphics, word processing, etc.)
- Accounting/record keeping
- marketing
- law

Home Economics

The Home Economics component of the program will include the topics of:

- Housing
- Fashion and textiles
- Food science
- Quantity foods
- Global foods
- Family studies

Technology Education

The Technology Education component of the program will include the topics of:

- Construction
- Manufacturing
- Transportation
- Electronics
- Communications/video production

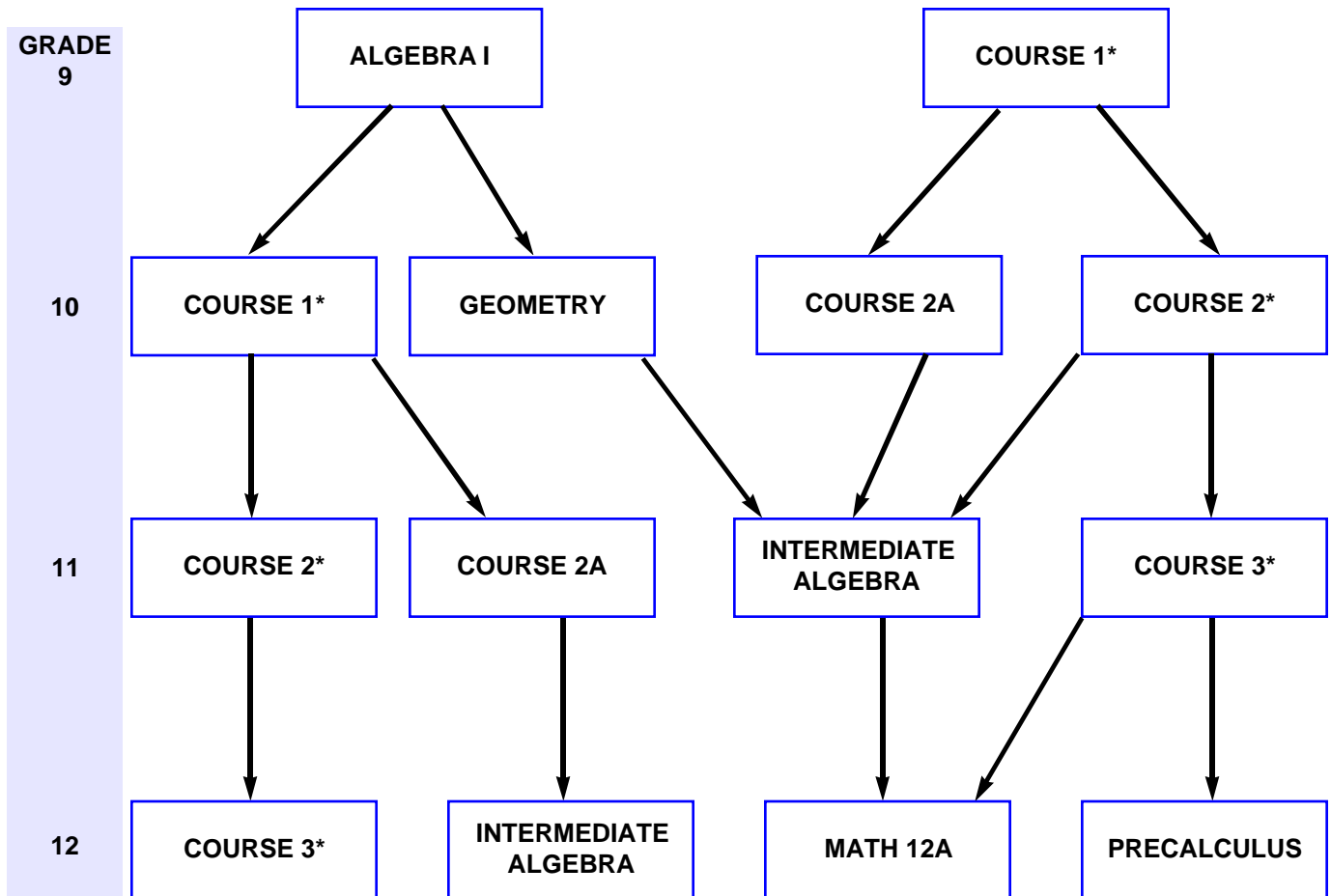
High School Mathematics Sequence



Students in the Syracuse City School District are presently able to earn a sequence in mathematics by starting with either Algebra I or Course 1 as ninth-graders. They may pursue various routes to achieve a sequence designation as twelfth-graders. **Chart A** portrays current practice in Syracuse, while **Chart B** indicates how that practice could be modified by the introduction of the new Mathematics Assessment in June, 1999. Though schools can continue to use Course 1 for a minimum requirement, and Course 2 and 3 develop a sequence until January 2002, teachers will wish to begin thinking about new patterns toward a Mathematics Sequence designation.

Chart A

Suggested High School Mathematics Sequences for College-Bound Students Starting with Algebra I or Course 1 in the Ninth Grade



* Courses which culminate with a Regents Examination

Source: Collins, William. Mathematics Supervisor, Syracuse City Schools.

Chart B

Phase-In of High School Mathematics Assessment for the Freshman of 1997 and Thereafter

Students would have to pass one of these mathematics assessments before they graduate. For example, the student entering in September 1997 could pass Course 1 in June 1998 (or continue to challenge it until January 2002) or they could wait and take the Math "A" exam in June 1999 (or later). Schools with variances would be permitted to use their assessments in June 1998, but after that they would have to choose between Course 1 or Math "A" exams beginning in June 1999.

MATH PHASE-IN					
ENTER GRADE 9 SEPT. 1997	ENTER GRADE 9 SEPT. 1998	ENTER GRADE 9 SEPT. 1999	ENTER GRADE 9 SEPT. 2000	ENTER GRADE 9 SEPT. 2001	ENTER GRADE 9 SEPT. 2002
Course 1 55/65*	Course 1 55/65	Course 1 55/65	Course 1* 55/65		
OR	OR	OR	OR		
Math "A" 55/65 in June 1999	Math "A" ** 55/65 in June 1999	Math "A" 55/65	Math "A" 55/65	Math "A" 65	Math "A" 65

* Freshmen of 1997-2000 can receive local diploma credit by attaining a score of 55-64 on a Regents examination (if permitted by their district), but they would need a 65 minimum score for a Regents diploma. Freshmen of 2001 and thereafter will need a minimum score of 65 for a diploma.

** Math "A" based on the Mathematics Standard of the *Learning Standards for Mathematics, Science, and Technology*. (Specific content outline for the assessment in the March 1997 *MST Resource Guide*.) Prototype exam available in Spring 1998.