CREATING STRONG K-12 MATHEMATICS CURRICULUM GUIDES 4

Key Resources For Curriculum Development

THE CURRICULUM DEVELOPMENT PROCESS

1. Convening A Mathematics Curriculum Development Committee
2. Identifying Key Issues And Trends In Mathematics Education
3. Assessing Needs
4. Developing A K-12 Program Philosophy
5. Developing K-12 Program, Grade-Level And Course Goals
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7. Identifying Resource Materials
8. Developing And/Or Identifying Assessment Items, Instruments
9. Implementing The New Program
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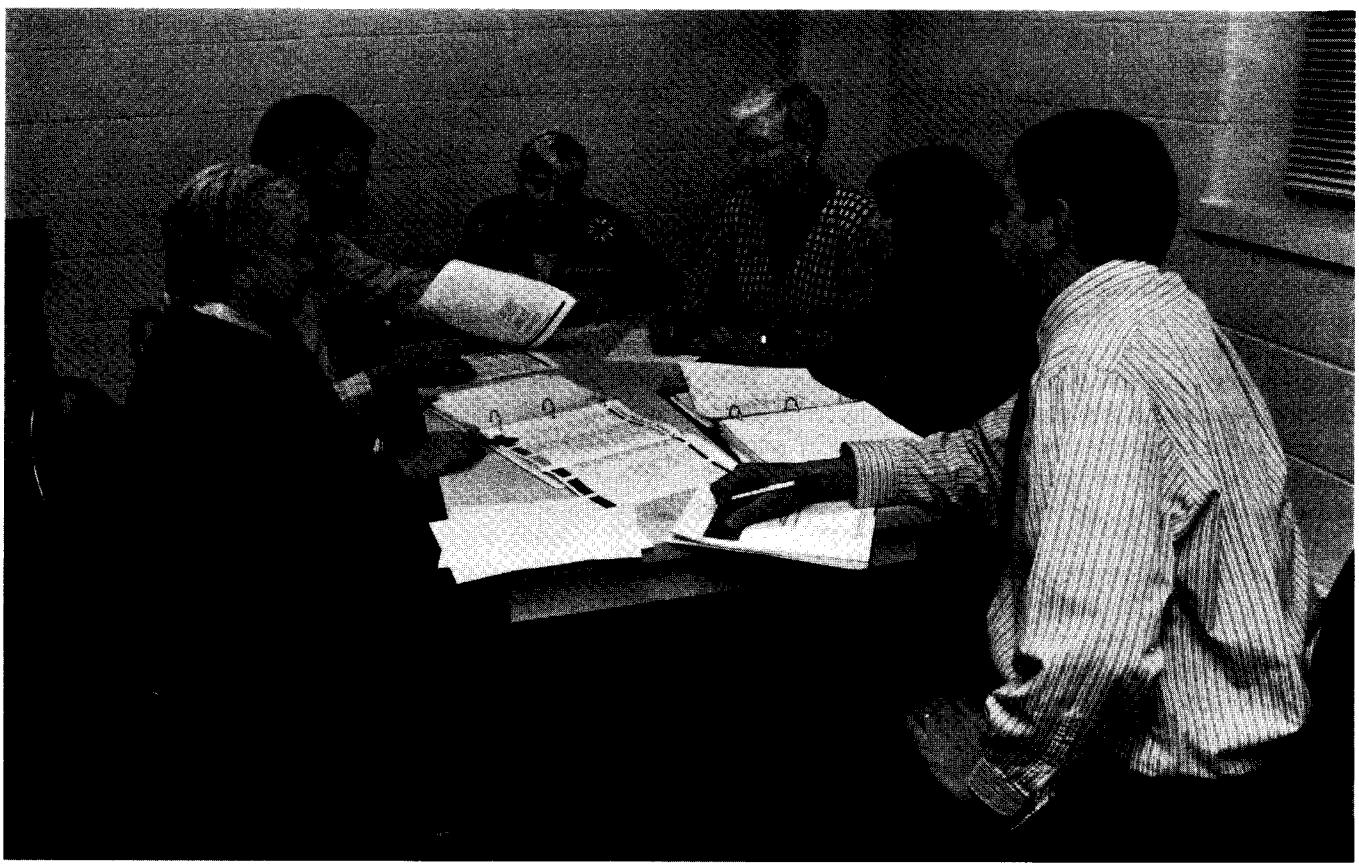
11. Evaluating The Success Of The New Program

PHILOSOPHY STATEMENTS
GOALS STATEMENTS
SAMPLE CURRICULUM GUIDE FORMATS
SAMPLE CRITERION-REFERENCED ASSESSMENTS



A district mathematics curriculum guide is a structured, written document that delineates the philosophy, goals, objectives, learning experiences, instructional resources and assessments that comprise the mathematics program. Additionally, a district's mathematics curriculum provides a critical link between national and state guidelines and frameworks and the classroom.

Accordingly, an exemplary guide which assists in planning and implementing high-quality mathematics instruction:

- establishes a clear philosophy and set of overarching goals that guide the entire program and the decisions made that affect each aspect of the program;
- establishes sequences both within and between levels and assures a coherent and articulated progression from grade-to-grade and course-to-course;
- outlines a basic framework for what to do, how to do it, when to do it, and how to know if it has been achieved;
- allows for flexibility, and encourages innovation and experimentation within an overall structure;
- promotes interdisciplinary approaches and the integration of curriculums, when appropriate;
- suggests methods of assessing the achievement of the program's goals and objectives; and
- provides a means for its own ongoing revision and improvement.

The development of such a school or district curriculum guide should not be viewed as the culmination of the curriculum development process, but rather as an essential way station along the path of ongoing curriculum development and implementation. Chances are no guide will be perfect; no guide will ever be a finished product; and no guide will be free from criticism. To be effective, however, a guide must earn acceptance by teachers and must be deemed educationally valid by parents and the community at large. This acceptance will be far easier to attain when the curriculum guide is:

- consistent with what is known about child growth and development;
- based upon clear convictions about teaching and learning;
- articulated from kindergarten through Grade 12;
- easy to use by all teachers;
- filled with samples, examples and suggested resources; and
- collaboratively developed by a broadly-based committee of teachers and other interested stakeholders.

In addition, a guide stored on disk can readily be edited and a guide distributed in loose-leaf format can readily be updated. These common strategies contribute to the ongoing nature of curriculum development and allow for quick revision via the addition of new activities or materials and help to keep the guide a current, useful and "living" document.

Key Resources For Curriculum Development

A high-quality curriculum guide in any discipline is the result of a carefully planned process that integrates the efforts of many and is supported by a broad array of resources.

Among these resources are, first and foremost, the **people** who comprise the mathematics curriculum development committee. Suggestions about the composition of such a committee are made in the next section of this chapter. In addition, consultants with broad curriculum development experience, workshop leaders for professional development, discussion leaders for focus groups and grade-level discussions, and evaluators to gather and summarize existing data all are often part of the curriculum development process.

Time also is essential – time for people to think, to research and to write. After-school, evening or weekend meetings often are not particularly effective. Effective curriculum development requires released time, summer work or a combination of both. Half-day or full-day released-time meetings on a biweekly or monthly basis can be productive, but frequently require either individual or subcommittee work between meetings. Summer work has proven to be successful because participants can devote their complete attention to the task. Many committees use one year or one summer to complete a draft for review and piloting, and then make revisions during a second summer based on written feedback and focus group discussions. Regardless of the exact scheduling, considerable time is required to do the job completely and correctly.

After a guide is first distributed, time must be allocated for professional interaction and sharing as teachers experiment with new techniques and become comfortable with revised expectations.

It is unnecessary to reinvent the wheel each time a curriculum guide is developed. Rather, the process should draw upon a range of **available materials and resources** that allow curriculum committees to adopt and/or adapt pieces and sections that meet local goals and needs. Among the source materials that should be

available to every mathematics curriculum development committee are:

- *Curriculum and Evaluation Standards for School Mathematics* (1989), *Professional Standards for Teaching Mathematics*, (1991), and *Assessment Standards for School Mathematics* (1995), all from the National Council of Teachers of Mathematics;
- this guide, the *Connecticut Mastery Test Mathematics Handbook* (1994), and the Connecticut Academic Performance Test *CAPT Handbook for Improving Instruction and Assessment in Mathematics* (1996), all from the Connecticut State Department of Education;
- blueprints to the next generations of CMT and CAPT (see Appendices B and C);
- the curriculum guide and textbooks currently in use;
- exemplary curriculum guides from other school districts and exemplary frameworks from other states;
- the 1997 *Connecticut K-12 Mathematics Evaluation Guide: An Evaluation and Implementation Tool*, from the Connecticut Academy for Education;
- professional journals, particularly *Teaching Children Mathematics*, *Mathematics Teaching in the Middle School*, and *The Mathematics Teacher*, all from the National Council of Teachers of Mathematics;
- the U.S. Department of Labor's 1991 SCANS (Secretary's Commission on Achieving Necessary Skills) report to aid in school-to-career transition (see Appendix A); and
- selected professional books, research reports, and national studies and reports.

Finally, adequate **funding** also is essential to advance the curriculum development process. Funds may be needed for items such as:

- salaries for school staff members who participate in the development work or for substitute teachers covering for released staff members;
- cost of secretarial services and duplication of materials;
- purchase of materials, professional literature and equipment;
- fees for consultant services;
- travel expenses to visit other school systems;
- printing sufficient copies of the pilot/review version and the final version of the guide; and
- cost of professional development needed to implement the guide.

THE CURRICULUM DEVELOPMENT PROCESS

The development of an effective curriculum guide is a multistep, ongoing and cyclical process. The process progresses from evaluating the existing program to designing an improved program to implementing the new program, and then back to evaluating the revised program.

Many school districts carry out this process in a planned and systematic manner that includes the 11 components listed in Figure 4.1. Each of these components is addressed in the sections that follow.

Figure 4.1

Components Of An Effective Curriculum Development Process

Planning
1. Convening a curriculum development committee
2. Identifying key issues and trends in mathematics education
3. Assessing needs

Developing
4. Developing a K-12 program philosophy
5. Developing K-12 program, grade-level and course goals
6. Developing and sequencing grade-level and course objectives
7. Identifying resource materials
8. Developing and/or identifying assessment items and instruments

Implementing
9. Implementing the new program

Evaluating
10. Updating the new program
11. Evaluating the success of the new program

1. Convening A Mathematics Curriculum Development Committee

A curriculum development committee, consisting primarily of teachers who represent the various schools and grade levels in a district, and also including administrators, members of the public and perhaps students, becomes the driving force for curriculum change and the long-term process of implementing the curriculum. It is critical that such a committee be led by an effective, knowledgeable and respected chairperson and include knowledgeable and committed members who gradually become the district's de facto "mathematics brain trust"

during the development phases of the process as well as the implementation phases.

2. Identifying Key Issues And Trends In Mathematics Education

The first step in any curriculum development process is "getting the lay of the land." Some curriculum developers call this initial step conducting internal and external scans that survey the "landscape" of the discipline both within the district and across the nation. Such a scan allows a curriculum committee to identify key issues and trends that will undergird the needs assessment that should be conducted and the philosophy that needs to be developed.

These scans often begin with the committee reading and discussing such timely reports as *Everybody Counts: A Report to the Nation on the Future of Mathematics* (1989) from the National Research Council or recent "Curriculum Updates" from the Association of Supervision and Curriculum Development that focus on mathematics. Committee members also should be provided with recent district CMT and CAPT results and be familiar with the instructional materials in use throughout the program. In addition, landscape scans should involve building familiarity with newly available instructional materials – particularly those that may eventually be adopted to help implement the new curriculum. Committee members also should broaden their perspectives and gather information by visiting other school systems that are recognized leaders in mathematics education.

In the process of surveying the landscape of mathematics, committee members are likely to identify many of the following issues and trends that will need to be addressed as the curriculum development process moves forward:

- meeting the needs of all students;
- learning theory and other cognitive psychology findings on how students learn;
- what determines developmental readiness or developmental appropriateness;
- the knowledge of and readiness for change on the part of teachers;
- the role, availability and type of calculators;
- the role and availability of computers;
- scheduling issues;
- the testing programs currently in place; and
- professional development.

3. Assessing Needs

Armed with a common set of understandings that arise from the identification of issues and trends, a curriculum development committee is wise to conduct a needs assessment to determine the perceptions, concerns and desires of each of the stakeholders in the process. For example:

- teachers may be dissatisfied with older content and techniques in light of recent research;
- test scores may be declining or be lower than expected in some or all areas;
- teachers may not have materials or may not know how to use manipulatives to enhance understandings;
- teachers may want to make far greater use of technology to enhance learning;
- teachers and others may wish to relate the content of the mathematics program more closely to contemporary problems and issues;
- teachers may be looking for ways to increase the amount of interdisciplinary work in which students are engaged;
- students may express a need for different and enriched curricular opportunities; or
- parents and others may have concerns about an apparent de-emphasis on multidigit computation with paper and pencil.

Whatever the particular circumstances, an effective curriculum development process usually entails a structured needs assessment to gather information and guide the curriculum development process.

Curriculum development can be viewed as a process by which the meeting of needs leads to improvement of the current status to arrive at desired outcomes. Regardless of the theory or model followed, curriculum developers should gather as much information as possible on desired outcomes or expectations of a high-quality mathematics program, on the current status of student achievement, and on actual program content, as well as on the concerns and attitudes of teachers, administrators, parents and students.

The information commonly gathered through surveys, structured discussions and test data most frequently includes:

- teachers analyzing the present curriculum to identify strengths, weaknesses, omissions and/or problems;

- teachers at each grade level identifying what they perceive to be the most serious problem areas within the curriculum;
- a detailed analysis of state and local test data, including CMT and CAPT scores, grade-level criterion-referenced test data, and course final examination results;
- meetings with teachers, guidance counselors and administrators to generate suggestions for change and improvement; and
- parents and other members of the community being surveyed or invited to community meetings to ascertain their concerns and expectations for the program.

Excellent resources for conducting a needs assessment are *A Guide for Reviewing School Mathematics Programs* published jointly in 1991 by the National Council of Teachers of Mathematics and the Association for Supervision and Curriculum Development and *Connecticut K-12 Mathematics Evaluation Guide: An Evaluation and Implementation Tool* published in 1997 by the Connecticut Academy for Education. In addition, curriculum development committees may find the "Mathematics Teacher Questionnaire" in Appendix F to be useful.

The data collected from the needs assessment in conjunction with the information obtained from the original scans and the various resources listed on page 169 become the basis upon which the entire curriculum – from philosophy to goals to assessment – is then built.

4. Developing A K-12 Program Philosophy

"Why learn mathematics?" "Upon what guiding principles is our mathematics program built?" "What are our core beliefs about teaching and learning mathematics?" These are among the fundamental questions that the overarching philosophy of the program must answer. As such, the program philosophy provides a unifying framework that justifies and gives direction to all mathematics instruction.

Having studied curriculum trends and assessed the current program, curriculum developers should be ready to construct a draft *guiding philosophy* for the K-12 mathematics program. Such a philosophy or set of beliefs should be more than just "what we think should be happening," but rather "what our curriculum is actually striving to reflect."

Like most of the curriculum development process, it is not necessary to create a philosophy out of thin air or to reinvent wheels. Accordingly, four sample program philosophies and sets of beliefs are presented for consideration and adaptation. Figure 4.2 provides a checklist for evaluating program philosophy statements. Four examples of program philosophies are provided on pages 174 and 175.

Figure 4.2

Effective Philosophy Statements Have The Following Characteristics

Accuracy
- Claims that the philosophy makes for mathematics education are supportable.
- The philosophy makes an educationally appropriate case for the role of mathematics in the K-12 curriculum and the importance of mathematics education for all students.

Linkages
- The mathematics program philosophy is consistent with the district's philosophy of education.
- The philosophy provides a sound foundation for program goals and objectives.
- The district's teachers are sincerely committed to each belief outlined in the philosophy.

Breadth and Depth
- The philosophy is aligned with sound pedagogical practices.
- The philosophy provides a clear and compelling justification for the program.

Usefulness
- The philosophy is written in language that is clear and that can be understood by parents and other noneducators.

5. Developing K-12 Program, Grade-Level And Course Goals

While the K-12 program philosophy describes fundamental beliefs and helps to inform the process of instruction, most curriculum guides also delineate K-12 program goals and grade-level and course goals to summarize the key cognitive and affective content expectations. For example, this framework is based on sets of program goals and content standards that are reflected throughout (see Chapter 2). Four sample sets of program goals are presented on pages 175 and 176.

6. Developing And Sequencing Grade-Level And Course Objectives

If the philosophy and goals of a curriculum represent the spirit or soul of the curriculum, then the grade-level and course objectives represent the core or heart of the curriculum. The specific grade-level and course objectives include clear expectations for what is to be learned.

In selecting, writing and sequencing objectives, several key questions arise.

- Is the objective measurable and how will you know it is met?
- Is the objective sufficiently specific to give the reader a clear understanding of what the student should be able to do, without being so detailed as to make the statement labored or the objective trivial?
- Is the objective compatible with the goals and philosophy of the program and the real and emerging needs of students?
- Is the objective realistic and attainable by students?
- Are appropriate materials and other resources available to make the objective achievable?

As objectives are selected and written, they must be organized in an orderly fashion. This order can be achieved in numerous ways: by grade, by strand, by unit, by sequential level of instruction, or through some combination of these. Decisions about the organization of a mathematics curriculum guide must be made carefully and must reflect the overarching philosophy of the program and the preferences of the teachers who are to use the guide.

- A **graded** structure organizes objectives by the grade in which a student is enrolled and is the most commonly used structure.
- An organization by **unit** groups objectives by main topics. Units may or may not be of differing levels of difficulty and may be large or small, sequential or nonsequential. A unit organization is most commonly used for middle or high school courses.
- A **strand** organization places all of the objectives for a specific topic or strand together in a sequential order, without regard to specific grade. Such an organization lends itself to individual instruction and continuous progress within a strand.
- A **sequential** organization outlines objectives in a continuous chain without regard for grade level or strand, and allows for individual student progress along a continuum of skills and experiences.

An effective guide often incorporates more than one format. For example, a common arrangement lists objectives grouped by strand within each grade level. In this manner the third grade teacher is provided with a complete list of the third grade objectives organized by strand or major topic. However, it is important for this teacher to have access to the second grade objectives containing skills that may have been introduced, but not taught for mastery, as well as forthcoming fourth grade objectives. This information often is provided in a scope and sequence listing by strand that would place the third grade measurement objectives, for example, in the context of the entire K-8 measurement strand.

Among the most important roles of grade-level and course objectives are to assure smooth transitions and curricular coordination between levels, particularly between elementary and middle schools, and between middle and high schools.

In addition to the delineation and sequencing of content via objectives, many curriculum guides provide additional information to help teachers more effectively implement the curriculum. For example, some curriculum guides:

- provide an example of what is meant by each objective;
- suggest instructional techniques and strategies for teaching specific objectives;
- suggest appropriate instructional materials that support specific objectives;
- provide information on how the objectives can be evaluated; and
- suggest interdisciplinary links, such as literature connections.

Accordingly, curriculum developers have a range of options for formatting and designing an effective curriculum guide. Five sample curriculum guide formats are provided on pages 178 – 205.

7. Identifying Resource Materials

An effective curriculum guide goes beyond a listing of objectives and identifies suggested instructional resources to help answer the question, "What instructional materials are available to help me meet a particular objective or set of objectives?" As teachers and programs move away from the single textbook approach and employ a broad range of supplementary materials and instructional modules for particular units, e.g., computer software, it is increasingly important that the curriculum guide link available resources to curriculum objectives.

Most of the sample curriculum guide formats shown at the end of this chapter include resource materials.

8. Developing And/Or Identifying Assessment Items, Instruments

In many cases, the glue that holds an entire curriculum together is a set of grade-level criterion-referenced tests and course final examinations that answer concretely the question, "How will I know that my students know and are able to do what is expected of them?" This culminating piece of the curriculum development process helps to focus instruction and ensures the often elusive, but critical, alignment of curriculum, instruction and assessment.

Common grade-level and course criterion-referenced assessments should be created along with the curriculum and become part of the curriculum guide itself. They help to clarify exactly what the grade or course objectives mean and provide a common standard for evaluating how successfully they are achieved.

Two sample criterion-referenced assessments are presented on pages 206 – 230 at the end of this chapter.

9. Implementing The New Program

Traditional practice too often involves sending a committee away for several after-school meetings and two weeks of summer writing as the prelude to a back-to-school unveiling and distribution of the updated or revised math curriculum. Obviously, the process envisioned here proposes a much more professional approach to both development and implementation. Instead of assuming that the process ends with the publication of a new guide, an effective committee continues to oversee the implementation, ongoing updating and evaluation of the curriculum.

It is important to remember that any innovation introduced within a school district – including a new mathematics curriculum – requires time and support to be fully implemented. First, teachers need time and opportunities to become **aware** of the new curriculum and its overall design, particularly how it differs from the past. Then teachers need time and opportunities to become **familiar** with the new curriculum – often school or grade-level sessions that focus on those specific parts of the curriculum for which individuals are responsible. Next, teachers need at least two years to **experiment** with the new curriculum and materials in their classrooms before the new curriculum is fully **implemented** and comfortably integrated into day-to-day practice. It is critical that the curriculum development committee, mathematics resource teachers and principals are aware of and available to nurture this process.

10. Updating The New Program

In this age of word processing and loose-leaf curriculum guides, it is easier than ever to update the guides and keep them as living, changing documents. One of the most common methods of periodically updating a curriculum guide is through grade-level meetings designed to share new materials, new activities, new units, new assessments, and even student work that support the achievement of the curriculum goals that were unknown or unavailable when the guide was first developed. These approaches are invaluable professional development opportunities wherein teachers assume ownership of the curriculum they are responsible for implementing. In this way, the guide becomes a growing resource for more effective program implementation. Mathematics resource teachers are effective vehicles for the preparation and distribution of these updates.

11. Evaluating The Success Of The New Program

The curriculum development cycle ends and then begins again with a careful evaluation of the effectiveness and impact of the program. Using surveys, focused discussions and meetings such as those described earlier in this chapter regarding assessing needs, a curriculum development committee should periodically gather data on perceptions of programmatic strengths, weaknesses and needs; preferences for textbooks and other materials; and topics or objectives that do not seem to be working effectively.

Data from these surveys and meetings then must be combined with a careful analysis of more numerical data on the program, such as:

- ongoing grade-level and course criterion-referenced exam data;
- CMT results (overall, over time, by objective and desegregated by subpopulations);
- CAPT results (overall, over time, by released item and desegregated by subpopulations);
- course enrollments (particularly by level in middle and high schools); and
- SAT and AP results.

This detailed review and analysis of quantitative and qualitative information on a program's impact and on people's perceptions of its strengths and weaknesses forms the foundation for the next round of curriculum development and improvement.

PHILOSOPHY STATEMENTS

Four sample philosophy statements follow:

SAMPLE PHILOSOPHY STATEMENT 1
(Source Unknown)

Mathematics instruction must provide experiences for children that are consistent with well-established Piagetian theories of cognitive development. These theories hold that children progress through stages of learning from concrete to representational (pictorial), to abstract or formal, and that **understanding** comes only through ample opportunity for **developmental** learning.

Mathematics instruction in the primary grades introduces concepts that are the key building blocks upon which later mathematics education must rest. Students must be given ample time and material to develop these basic concepts and skills at the concrete operational level. Hands-on experiences with manipulatives are also important in the upper elementary grades when new concepts are introduced.

Mathematics instruction is far more than computational proficiency. The pervasive use of calculators and computers in society today makes it urgent that mathematics instruction go beyond mechanical training in computation. What is needed is a far better "number sense" so that the **reasonableness** of machine answers can be quickly ascertained. Students must develop skills in estimation and mental arithmetic, and an understanding of the size of numbers and of the logical consequences of mathematical operations.

Mathematics instruction for today's society must include training in logical thinking and other higher-level thinking processes which are transferable to a variety of problem-solving activities. The term "problem-solving" is no longer synonymous with "word problems" but includes all manner of skill application in areas of logic, real-life problems, graphing, measurement, geometry, and probability and statistics.

SAMPLE PHILOSOPHY STATEMENT 2
(Bethel, CT Public Schools)

Definition

- Mathematics is a science of pattern and order and its relationship to the world in which we live.
- Mathematics is a way of thinking, making use of a network of related ideas and concepts.

Purpose

- Knowledge of mathematics "is essential for everyday life, for intelligent citizenship, for employment, as an integral piece of our ever-changing technological and information-based society, and as part of our overall human culture." (Pollok, 1992)

Performance

The knowledgeable mathematics student can do the following:

Concept Goal	Description
Number sense	• Has number sense and the ability to see relationships between abstract and concrete ideas
Decision making	• Uses math for critical and creative thinking in order to make decisions.
Problem solving	• Sets up problems using appropriate operations • Uses a wide variety of problem-solving techniques • Demonstrates underlying mathematical features of a problem • Works well with others to solve problems • Communicates solutions in appropriate mathematical terminology

Major Beliefs

Mathematics competence is acquired by:

- A structured curriculum that balances:
  1. computational skills;
  2. reasoning strategies;
  3. creativity; and
  4. abstraction.

Good mathematics instruction:

- involves visual, auditory and kinesthetic modalities;
- is presented with real-life uses: science=data; business=outcome charts;
- builds on past learning and understanding;
- actively involves students: manipulatives, technology; and
- is age and developmentally appropriate.

Technology allows the student to:

- focus on learning concepts;
- develop higher-order thinking skills;
- learn how to solve problems; and
- learn how to manipulate data.

SAMPLE PHILOSOPHY STATEMENT 3
(Region 15 Public Schools)

- We believe that students must be active in the learning process.
- We believe that mathematics instruction should be the development of the students' ability to solve problems.
- We believe that, since it is hard to determine the specifics that will be needed in the future, it is important that students learn how to learn and develop a willingness to continue learning.
- We believe that students mature cognitively at different rates, respond to differing kinds of motivations, and respond to different styles of teaching.
- We believe that students have different learning styles.
- We believe that, since each student is unique, we cannot justify the notion that all students should reach a fixed level of mathematical achievement. Further, we believe that mathematical experiences should be available to every student at his or her own level of ability and that each student should be exposed to the core math curriculum in Grades K-12.
- We believe that mathematics education should not be isolated from other curricular areas or disciplines.
- We believe that mathematics should be a judicious blend of concrete and abstract application and theory, skills and concepts.
- We believe that students should enjoy the study of mathematics.

SAMPLE PHILOSOPHY STATEMENT 4
(Source Unknown)

To learn the essential mathematics needed for the 21st century, students need a nonthreatening environment in which they are encouraged to ask questions and take risks. The learning climate should incorporate high expectations for all students, regardless of gender, race, handicapping condition or socioeconomic status. Students need to explore mathematics, using manipulatives, measuring devices, models, calculators and computers. They need to have opportunities to talk to each other and to write about mathematics. Instruction should emphasize problem solving, applications and higher-order thinking skills. Students need to work together to pose questions, analyze solutions, try alternative strategies and check for reasonableness of results.

The mathematics curriculum will focus on developing mathematical power and building self-confidence in one's ability to learn mathematics through a process of:

- solving problems;
- reasoning mathematically;
- communicating mathematically; and
- learning to value mathematics as it relates to other disciplines, real-world applications and lifelong learning.

This process involves:

- students as active participants in constructing their knowledge;
- students as users of appropriate technology;
- students using math as a tool beyond the mathematics classroom;
- students as users of alternative approaches;
- teachers capturing students' curiosity and encouraging them to speculate and pursue hunches;
- teachers as facilitators of learning as well as sharers of information;
- teachers providing opportunities for student interaction; and
- teachers focusing on multiple representations.

GOALS STATEMENTS

Four sample goals statements follow:

SAMPLE GOALS STATEMENT 1
(South Orange and Maplewood, NJ Public Schools)

Members of the Mathematics Curriculum Development Committee recognized that the traditional goals that focused on mastery of computational skills and facts were insufficient to meet the needs of students for the 21st century. They formulated these new goals to bridge the 20th and 21st centuries with appropriate mathematical literacy.

1. Students will be **confident, creative** and **curious** in their use of mathematics.
2. Students will develop **mathematical thinking, reasoning, conceptual and operational knowledge,** and **the ability to solve problems.**
3. Students will enhance their **understanding** and **application** of mathematics by **talking, listening, reading** and **writing.**
4. Mathematics instruction will involve students in **doing** mathematics by:

    - connecting with "real-life" experiences;
    - using real, representational and print materials;

- interacting with other disciplines;
- interacting with others; and
- using tools of technology.

SAMPLE GOALS STATEMENT 2
(Region 15 Public Schools)

To develop in each student:

- a conceptual understanding of mathematics;
- the skills of critical thinking, inductive and deductive reasoning, and problem solving;
- appropriate computational skills;
- the ability to apply mathematical concepts and skills in the study of other curricula, especially the social and physical sciences;
- the ability to apply mathematics to problems of everyday life, vocations and careers according to their own needs and interests;
- the ability to use mathematical tools and concepts for measurements and practical problem solving;
- an understanding of mathematical patterns and structures;
- the ability to use logical processes and make rational decisions; and
- a favorable attitude toward mathematics.

To achieve these goals, we must provide a curriculum that presents a core of concepts and skills and that is appropriate to varying student abilities and interests.

SAMPLE GOALS STATEMENT 3
(Adapted from the NCTM Standards, 1989)

1. **Learning the value of mathematics**
   The purpose of this goal is to focus attention on the need for students to understand the interaction between mathematics and other areas of life and the impact that interaction has had on our lives.
2. **Learning to reason mathematically**
   The process of making assumptions, gathering data and formulating an argument to support a theory is a basic skill in mathematics. Sound reasoning will be valued as much as a student's ability to find correct answers.
3. **Learning to communicate mathematically**
   This goal will be accomplished in the context of problem solving that involves students in reading, writing and talking the language of mathematics.
4. **Becoming mathematical problem solvers**
   The ability for students to problem solve through the process of discovering and applying the power and utility of mathematics will be developed.
5. **Becoming confident in their own mathematical abilities**
   Students will be assisted to realize that mathematics is a common, relevant, familiar and inescapable human activity and to empower them to trust their thinking skills by applying their mathematical abilities.

SAMPLE GOALS STATEMENT 4
(Source Unknown)

Students will:

- apply the basic concepts of mathematics;
- develop accuracy in arithmetic processes;
- develop skills in applying mathematical concepts to problem solving;
- learn to communicate mathematically;
- use the skills of deductive and inductive reasoning.;
- apply learned mathematical skills in their vocational pursuits;
- appreciate the importance of mathematics;
- develop confidence in and a favorable attitude toward mathematics; and
- pursue the study of mathematics for greater mastery.

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NCTM. *Professional Standards for Teaching Mathematics.* Reston, VA: NCTM, 1991.

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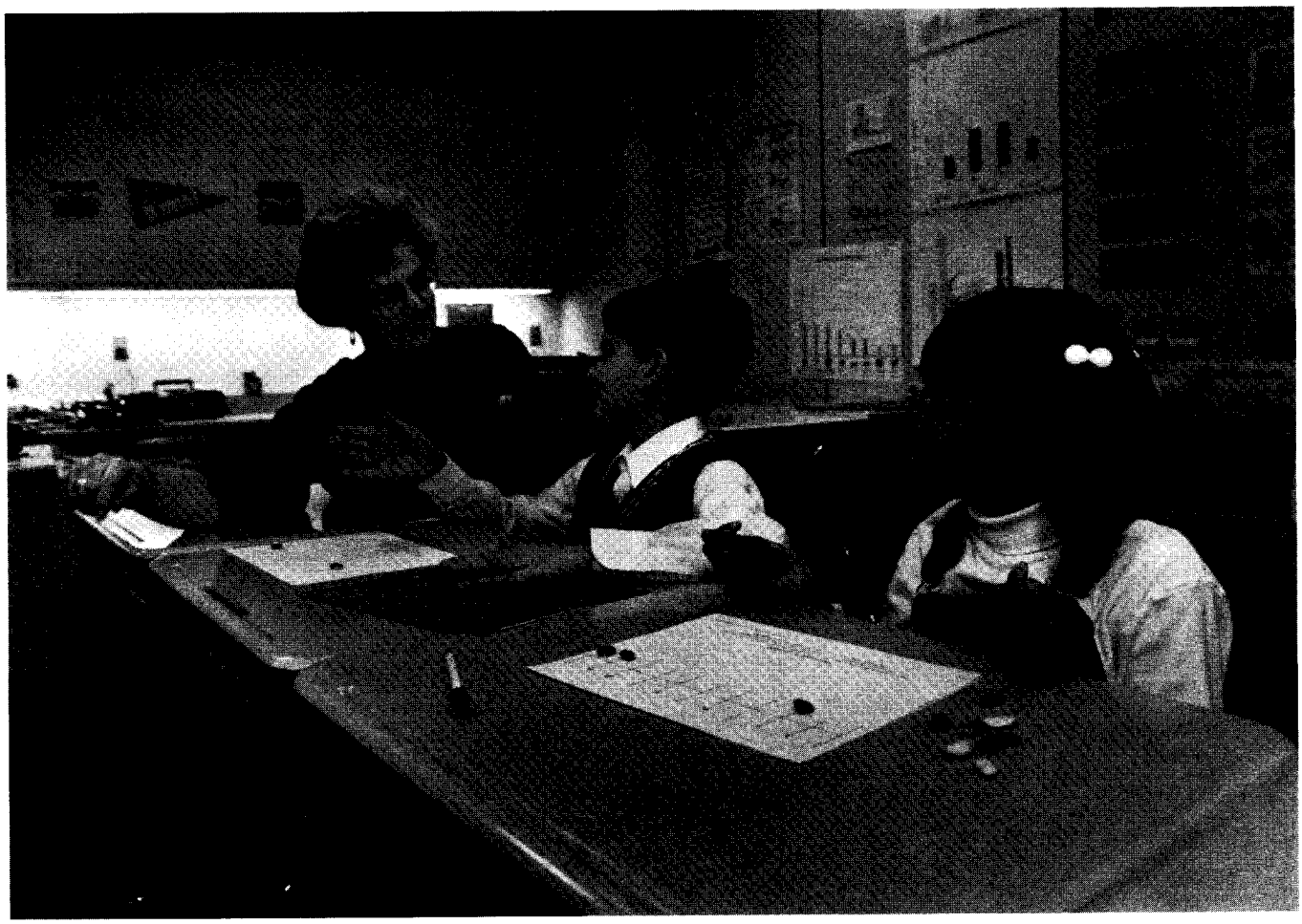


FIVE SAMPLE CURRICULUM GUIDE FORMATS

1. **STRAND: Fractions, Decimals and Percent**, Pages 179 and 180.
   From the Wallingford, Conn. Public Schools. Used with permission.

2. **MATH CURRICULUM: Grade Six**, Pages 181-187.
   From the Horace W. Porter School, Columbia, Conn. Used with permission from Mike Wallace.

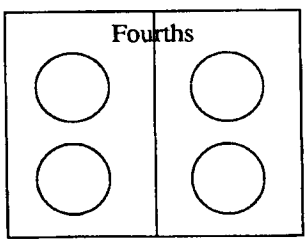
3. **NCTM STANDARD 10: Measurement**, Pages 188-190.
   From the National Council of Teachers of Mathematics. Used with permission.

4. **CLUSTER: Rational Numbers, Grade 6**, Pages 191-202.
   STRAND: Estimation, Fractions, Decimals, Percents
   From the Clinton, Conn. Public Schools. Used with permission.

5. **TRIGONOMETRY: A #143**, Pages 203-205.
   From the Wallingford, Conn. Public Schools. Used with permission.

WALLINGFORD PUBLIC SCHOOLS

STRAND: FRACTIONS, DECIMALS, AND PERCENT

Grade 4 students will:	Activities or Resources
Construct shapes and diagrams that have multiple lines of symmetry; find the value of the design and/ or its fractional parts.	Use Pattern Blocks, Tangrams, Color Tiles. Construct designs. Give a basic building block, such as the yellow pattern block hexagon, a value, and find the values of the design and its symmetrical parts. (MIS 151, MIS-A 42,55,65,68)
Show parts of a whole with models and pictures; identify and label fractions such as 1/2, 1/3, 1/4, 1/6, 1/8, 1/10, 1/12, 2/3, 3/5, etc.; and write fraction sentences about parts of a whole, including identifying equivalent parts.	Fold paper squares into triangular regions and write about the relationships using fractions. Later in the year, repeat the activity and use fraction, decimal, and percent notation.  Use pattern blocks, fraction squares, fraction strips, and make fraction books. Write sentences such as 1/2 = 2/4 and 1/2 + 1/3 + 1/6 = 1 without using the addition algorithm involving common denominator. Find the value directly from the model or picture. (MIS 97-101, MIS-A 18 ,44, 54, 65-66, 78-81, 88) ,(NC B 6-8), (AW 334A-4B)
Compare fractions using models and pictures. Write about the relationships using = and > symbols.	Fold a strip of paper into fourths. Fold another strip the same length into eighths. Identify the equivalent fractions by aligning the folds. Use the strips to compare 3/4 and 3/8. Use the > symbol for several months before introducing the < symbol. (See Counting, Comparing , and Ordering strand). (MIS 97-98)
Find fractional parts of a set. Look for, describe, and use patterns to identify and write about fractional parts and equivalent ratios.	Use fraction boards. Predict and find fourths of a set of 80 objects by arranging the objects in the rings. 1/4 = 20 2/4 = 40 3/4 = 60 4/4 = 80  5/4 = 100, etc. Connect to multiplication/division patterns. (MIS 43-45)

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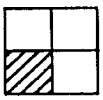
WALLINGFORD PUBLIC SCHOOLS

STRAND: FRACTIONS, DECIMALS, AND PERCENT

Grade 4 students will:	Activities or Resources
Use the ten-strip model and pictures to identify and write about fractional parts using common fraction and decimal notation.	 1/10 = .1, 4/10 = .4, etc.
Write addition sentences using common fractions and decimal notation to describe models and pictures. Use the notation interchangeably to demonstrate equivalence of fraction and decimal forms.	 3/10 + 1/10 = 4/10, so .3 + .1 = .4 (MIS 115-116, 137-139, 146-148, 166, MIS-A 42, 55, 66, 79-81), (AW 358A-B, 368 A-B)
Use the hundred-grid model and pictures to identify and write about fractional parts as fractions and percents. Use the notation interchangeably to demonstrate equivalence of fraction and percent forms.	Shade 1/4 of the 100-grid. Write about the shaded part as 25/100 and 25%. 1/4 = 25/100 = 25% (MIS 46-47, 140-141, MIS-A 18, 44, 54, 65-66, 78-81, 88), (AW 360A-B) 
Use models and pictures to construct, label, and write about mixed numbers.	Use pattern blocks, tangrams, strips, and grids. (MIS 113-116, 145-149), (NC B 9-10), (AW 364 A-B)
Connect fraction and decimal notation to money.	Quarters are 1/4 of a dollar or 25/100, or 25 cents, or 25% of a dollar. (MIS 48)
Describe and use patterns with fractions, decimals, and percents to estimate and find parts of a set.	1/4 of 100 = 25, so 25% of 100 = 25 2/4 of 100 = 50, so 1/2 of 100 = 50 and 50% of 100 = 50.
Create, estimate reasonable answers, and solve story problems that involve parts of a whole and parts of a set of objects.	(MIS-A 16-18, 42-43, 53, 55, 65)
Connect fraction and equivalence concepts to practical situations and other content areas.	(NC C 3-4)

MATH CURRICULUM

GRADE: **SIX**

HORACE W. PORTER SCHOOL, COLUMBIA, CONNECTICUT

GOALS/OBJECTIVES **THE STUDENT WILL:**	RESOURCES/SUGGESTED ACTIVITIES
PROBLEM SOLVING *Problem Solving should go on throughout the year. Problem situations should arise from daily classroom and real world situations.* -Draw a picture to solve problems. -Use guess and check as a problem solving strategy. -Work backwards. -Complete a table. -Make an organized list. -Use logical reasoning. -Look for a pattern. -Solve and write story problems with and without extraneous information. -Given a problem with missing data, make up appropriate data for solving the problem. -Identify the appropriate operation to solve story problems.	Addison-Wesley Problem Solving Experiences-Gr. 6 Tops Deck Level D Make It Simpler Try-A-Tile Math Olympiad problems New England Mathematics League problems Get It Together Calculators Tops Deck Mathworks See Games, Core activities, Gr. 3 A Collection of Math Lessons, Gr. 3-6 A Collection of Math Lessons, Gr. 6-8 Math & The Mind's Eye - Seeing Mathematical Relationships
ESTIMATION *Estimation should go on throughout the year.* -Estimate length, mass, volume, time, temperature, and quantity. -Estimate sums, differences, products, and quotients using rounding whole numbers and money amounts. -Estimate the magnitude of mixed numbers and decimals. -Estimate using front-end, clustering, and compatible numbers. -Discuss or write the strategy or procedure used for estimating. -Estimate a reasonable answer to problems involving fractions.	Classroom, everyday situations Mathematics...A Way of Thinking Ct. Mastery Test Mathematics Handbook Math In Stride 6

MATH CURRICULUM

GRADE: **SIX**

HORACE W. PORTER SCHOOL, COLUMBIA, CONNECTICUT

GOALS/OBJECTIVES **THE STUDENT WILL:**	RESOURCES/SUGGESTED ACTIVITIES
CALCULATION -Recall basic facts for all operations. -Add and subtract 2-, 3-, and 4-digit whole numbers, money amounts and decimals -Multiply and divide 2- and 3- digit whole numbers, money amounts and decimals by 1-digit whole numbers and decimals. -Multiply and divide whole numbers and decimals by 10, 100, and 1000. -Add and subtract fractions and mixed numbers with reasonable and appropriate denominators. -Multiply whole numbers and fractions by fractions and mixed numbers. -Use calculators to perform addition, subtraction, multiplication, and division. -Find percents of whole numbers.	Try-A-Tile Calculators See Games, Core activities, Gr. 3 -The Match Game -Reject Addison-Wesley Student Text, Gr. 6 The Math Solution Math In Stride 6 Middle School Mathematics Project-Factors & Multiples - I & II
CONCEPTS OF OPERATION -Draw an area model to illustrate 2-digit by 2-digit multiplication. -Model, by drawing or writing, multiplication of one by two digit factors with base 10 blocks. -Model, by drawing or writing, division of three digit dividends by one digit divisors with base 10 blocks. -Write story problems from number sentences (+,-,x,÷). -Write the number sentence needed to solve a story problem -Use +, -, x,÷, and = signs.	The Math Solution Picturing Addition, Subtraction, etc. series Mathematics...A Way of Thinking Moving On With Base Ten Blocks

MATH CURRICULUM

GRADE: **SIX**

HORACE W. PORTER SCHOOL, COLUMBIA, CONNECTICUT

GOALS/OBJECTIVES **THE STUDENT WILL:**	RESOURCES/SUGGESTED ACTIVITIES
NUMERATION: -Construct, read, write, and compare numbers to the hundred millions place. -Pictorially represent numbers less than 1000. -Identify alternative forms of expressing whole numbers less than 10,000 using expanded notation. -Identify alternative forms of expressing whole numbers less than 10,000 using regrouping. -Round numbers to the nearest hundredth, tenth, one, ten, hundred, and thousand. -Round money amounts. -Relate fractions, decimals, and percents to pictures and vice versa. -Rename fractions and mixed numbers as equivalent decimals and vice versa. -Rename fractions and decimals as equivalent percents and vice versa. -Relate equivalent mixed numbers and improper fractions. -Read and write Roman Numerals to 1000. -Read, write, compare, and pictorially represent decimals to tenths and hundredths (.01 - 2.99). -Locate points on number lines and scales.	Moving On With Base Ten Blocks Picturing Numeration See Games, Core activities, Gr. 3 A Collection of Math Lessons, Gr. 3-6 A Collection of Math Lessons, Gr. 6-8 Mathematics for Middle School - videotapes Pattern blocks, geoboards, base ten blocks, etc. Addison-Wesley Student Text, Gr. 6 Mathematics...A Way of Thinking The Math Solution Base Ten Blocks Math & The Mind's Eye - Modeling Whole Numbers Modeling Rationals Modeling Integers Modeling Percentages and Ratios Let's Pattern Block It

MATH CURRICULUM

GRADE: **SIX**

HORACE W. PORTER SCHOOL, COLUMBIA, CONNECTICUT

GOALS/OBJECTIVES **THE STUDENT WILL:**	RESOURCES/SUGGESTED ACTIVITIES
DATA ANALYSIS (Graphing, Probability, Statistics) -Identify correct information from graphs, tables, and charts. -Find the average, median, and range of a group of numbers. -Create bar graphs, line graphs, and pictographs from collected data. -Identify points on a coordinate graph. -Use recorded data to compare, draw conclusions, predict, and generate questions in written and oral form. -Solve problems involving elementary notions of probability and fairness. -Solve process problems involving the organization of data.	Middle School Mathematics Project -Probability - Activities III & IV Math & The Mind's Eye - Visual Encounters With Chance A Collection of Math Lessons, Gr. 6-8 The Math Solution
PATTERNS AND FUNCTIONS -Determine the rule and extend or complete patterns involving whole numbers and attributes. -Use variables to describe simple rules or patterns involving whole numbers.	Math & The Mind's Eye - Picturing Algebra -Seeing Mathematical Relationships A Collection of Math Lessons, Gr. 6-8 The Math Solution See Games, Core activities, Gr. 3 Pattern blocks, Attribute blocks Ct Mastery Test Mathematics Handbook Moving On With Pattern Blocks

MATH CURRICULUM

GRADE: **SIX**

HORACE W. PORTER SCHOOL, COLUMBIA, CONNECTICUT

GOALS/OBJECTIVES **THE STUDENT WILL:**	RESOURCES/SUGGESTED ACTIVITIES
MEASUREMENT -Determine elapsed time. -Figure change for purchases. -Measure lengths and draw lines to the nearest 1/8 inch and nearest half centimeter. -Measure weight in kilograms, grams, ounces, and pounds. -Measure capacity in liters, milliliters, and customary units. -Measure to determine perimeter, areas, and volumes. -Identify appropriate customary or metric measures for a given situation. -Convert measures of length and time.	Middle School Mathematics Project -Mouse and Elephant: Measuring Growth III & IV The Math Solution Measurement Menu A Collection of Math Lessons, Gr. 6-8
GEOMETRY -Identify, draw, describe, and classify geometric shapes and figures. -Identify or draw points, lines, and segments. -Identify or draw geometric transformations and lines of symmetry. -Recognize when two figures appear to be congruent or similar.	Middle School Mathematics Project -Spatial Visualization - Activity II The Math Solution Geometry Menu Math & The Mind's Eye - Looking at Geometry

CORE ACTIVITIES FOR GRADE 6 MATH EXPERIENCES

The following resources/activities should be experienced by all grade 6 students in order to facilitate consistent development of important math concepts and problem solving skills.

1. Addison-Wesley Problem Solving Supplement - Grade 6..

This is an instructional program consisting of 150 problem-solving experiences and a teaching strategy for problem solving. It may be taught via a problem-of-the-day approach, or as a complete unit, or in any other format the teacher desires. There are 30 clusters of five problems: a skill activity, a one-step problem, a multiple-step problem, and two process problems.

The critical instructional component is the student discussion that takes place after students have had an opportunity to work the problems. Allow for students to share their thinking and strategies for solving the problems. Teachers should focus on the processes/strategies used, rather than the answer, Also, encourage students to write frequently in math class.

The mathematics needed to solve the problems lags the curriculum objectives by about half a year. For example, the objectives needed to solve a problem in the middle of the third grade book were covered at the beginning of the third grade book.

2. Try-A-Tile for addition, subtraction, multiplication,and division practice with a problem solving focus.

3. The Palindrome Problem from A Collection of Math Lessons, Gr. 3-6. This is a good problem-solving activity for use with cooperative grouping. It also provides opportunities for computational practice and pattern searching.

4. The Popcorn Problem from A Collection of Math Lessons, Gr. 3-6. A range of mathematical concepts is used in this particular lesson. In the number area, students are asked to focus on ratio and proportion and fractional equivalence. In the statistics area, students collect, organize, represent, and interpret data, are introduced to frequency distribution, and explore mean, median and range. In the probability area, students discuss the representation of the probability of an event.

5. The Measurement Menu is a menu approach to a hands-on study of the metric system. Various activities require that student estimate, then find exact measurements. See The Math Solution.