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ABSTRACT

"Modeling Mathematics Teaching Excellence" is a professional development process designed to enable mathematics departments to conduct an assessment of how well their program is meeting the needs of their early adolescent students. It is a modified edition of the Mathematics Assessment Process for the Middle Grades (MAP), a year-long self-study used by schools to examine and align their mathematics education programs to new national goals articulated by the National Council of Teachers of Mathematics (NCTM) in its "Curriculum and Evaluation Standards" and the "Professional Standards for School Mathematics." After an introduction providing an overview of the process and an implementation outline, this implementation guide is presented in five sections. Section I includes "Criteria for Excellence" in the areas of curriculum, learning experiences, problem solving and critical thinking, diverse needs, attitudes, relevance to students, faculty, parent and community involvement, and assessing progress. A list of accompanying ideals and an instrument for self assessment in each of these areas is provided. Section II which explains how to use MAP, provides information on how to: initiate the process, use the assessment instruments, and summarize assessment data. Section III supplies the necessary assessment instruments: Mathematics Classroom Observation (MCO); Mathematics Teacher Interview (MTI); Mathematics Teacher Survey (MTS); and Student Resource for Learning Mathematics (SR). Section IV provides information on how to analyze the data collected and gives exemplary models to work from. Section V describes a framework for planning action based on the results of the assessment. A glossary of terms and a list of distributors of innovative mathematics teaching materials is provided. (MDH)

Modeling Mathematics Teaching Excellence

A Project of the
Center for Research in
Mathematics and Science Education
North Carolina State University

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Modeling
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CONTENTS

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Modeling
Mathematics
Teaching
Excellence

Implementation Guide

by

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(Revised Edition)

MODELING MATHEMATICS TEACHING EXCELLENCE

Introduction

MODELING MATHEMATICS TEACHING EXCELLENCE is a professional development process designed to restore to teachers the responsibility for implementing more effective mathematics teaching and learning in their classrooms. It is based upon the ***Mathematics Assessment Process for the Middle Grades (MAP)***, a year-long self-study used by schools to examine and align their mathematics education programs to new national goals. ***MAP*** engages interdisciplinary teams in an intensive analysis that answers the question, "How well is the mathematics program in our school meeting the needs of our early adolescent students?"

MODELING MATHEMATICS TEACHING EXCELLENCE is a *modified edition* of ***MAP***, created so mathematics departments, working without the involvement of additional faculty or community members, can conduct an assessment within a shorter time period.

Field-tested in 1990-1991 with funds from the Eisenhower Mathematics and Science Education Act, MODELING MATHEMATICS TEACHING EXCELLENCE enables teachers to analyze and update their mathematics program without relying upon external "experts" or managers to lead the mathematics improvement effort. The project originated at the Center for Research in Mathematics and Science Education (CRMSE) at North Carolina State University, a center within the North Carolina Mathematics and Science Education Network. The instruments and action planning guidelines were successfully used by teaching teams from ten middle-grades schools in very diverse communities in Georgia, North Carolina, New Jersey, and Wisconsin.

The ***MAP*** process is a simple one. Working under the direction of a teacher leader (or several co-leaders), the mathematics department studies the program it offers students. Using the structured ***MAP*** assessment tools in this volume, teachers document the program's strengths and the areas in which improvements are indicated. Colleagues conclude the process with a plan for updating and changing the mathematics program as they deem necessary. Participants learn to use observation and self-assessment techniques that help clarify their thinking about their own mathematics teaching and plan new or alternative strategies that will encourage improved student learning.

This process is unique in that a school's ***teachers*** are directing both the analysis of needs and the implementation of improvement. Consultants from the school district's central office mathematics department or the school's administration serve, upon request, as resources in each phase of the assessment.

MODELING MATHEMATICS TEACHING EXCELLENCE

Overview of the Process

A look into mathematics classrooms reveals numerous outstanding examples of excellent middle-grades teaching. Many teachers routinely engage their students in mathematical thinking, active learning, question posing, and exploratory mathematical applications. But behind the classroom door, these excellent teachers are too often working alone, prevented by schedules and workloads from sharing their experiences and expertise with the teacher in the next room. This isolation across classrooms has greatly limited teachers' potential as decision makers and leaders of mathematics improvement.

MODELING MATHEMATICS TEACHING EXCELLENCE is designed to reunite teachers and empower them to improve mathematics teaching and learning in their schools. The project enables teachers to open their doors to one another, demonstrating and sharing with colleagues the practices they use in teaching mathematics. With this exchange as a foundation, the mathematics staff conducts an assessment of its overall mathematics program and prepares an action plan for improvement in the areas of weakness that the team identifies.

The assessment criteria and instruments are specifically designed for middle-grades schools, but they can easily be modified and adapted to the needs of elementary or high schools, as well.

Three assumptions underlie this project:

1. Criteria for excellence in mathematics education are well-established by research but too little practiced in actual classrooms;

2. Successful teachers make the best models of effective practice for colleagues; and

3. Systematic collegial exchange of ideas and sharing of successful practices effectively stimulate improved mathematics teaching and learning.

Anticipated Benefits of Outcomes of the Project

Three benefits are expected for teachers who undertake this assessment. *MAP* will:

1. Prepare mathematics teacher leaders and their colleagues to collaborate in developing, updating, and expanding their mathematics teaching;

2. Increase teacher use of promising mathematics teaching practices in participating schools; and

3. Establish in the school a practical model of professional development that relies on colleagues assisting colleagues without having to turn prematurely to "outside experts" to solve school site problems.

MODELING MATHEMATICS TEACHING EXCELLENCE

Implementation Outline

Overview

Each assessment site designates one or more teacher leaders to coordinate a series of action research seminars with four to eight colleagues from the mathematics department. Using selected portions of the ***Mathematics Assessment Process for the Middle Grades (MAP)***, the research-based package of mathematics program assessment materials that forms the core of this implementation guide, the seminar members examine the match between their current instructional program and the evolving goals of mathematics education that are articulated by the National Council of Teachers of Mathematics in its **Curriculum and Evaluation Standards** (1989) and in the **Professional Standards for School Mathematics** (1991).

Joining in periodic meetings, teachers use the assessment tools provided in this manual to guide their discussions. Through observations in one another's classrooms and informal examinations of their current practices, teachers document the consistency of their mathematics teaching with the elements of exemplary practice identified in ***MAP***. Following a several-month period of data gathering, the group develops an action plan to incorporate appropriate new methods into their classrooms and program planning.

Participation in the ***MAP*** action research seminar accomplishes the following goals:

1. Increases teachers' knowledge of exemplary mathematics teaching strategies, especially those incorporated in the NCTM **Curriculum and Evaluation Standards** and **Professional Standards for School Mathematics.**

2. Develops teachers' understanding of and ability to use these teaching practices with their middle-grades mathematics students.

3. Engages teachers in collaborative action research that expands their professional knowledge and encourages them to try out new approaches to mathematics teaching that include:

   - Cooperative and active learning strategies
   - Manipulatives and applied mathematics learning
   - Computers and calculators
   - Innovative approaches to teaching higher order mathematical content

4. Demonstrates a staff development model that classroom teachers can continue use within their school to initiate and sustain improved mathematics teaching and learning.

This is an action research edition of the ***Mathematics Assessment Process for the Middle Grades***. It modifies the more extensive ***MAP*** self-study, providing a limited number of assessment instruments--interviews, surveys, and observations--to enable a concentrated and shorter assessment.

The Action Research Seminar

The assessment process engages teachers in an "action research" seminar conducted by colleagues. An action research seminar is an ongoing meeting of practitioners who are implementing practical research to improve their teaching. This approach is used increasingly by mathematics educators to redesign their teaching and curricula. Action research seminars have been found to be excellent means for teachers to collaboratively update their instructional programs, making them more responsive to the changing needs of their students, without relying upon outsiders or supervisory personnel.

Spurred by new understandings about how children learn mathematics, many teachers are seeking ways to integrate their best current practices with recent recommendations from mathematical scientists, educators, and researchers. By working with colleagues in open-ended, self-directed research seminars and discussions, teachers become the key agents for updating mathematics education in their schools.

The ***MAP*** action research seminar is an inquiry that reflects a new emphasis in mathematics teaching, namely the promotion of mathematical problem solving, questioning, and creative thinking. When teachers learn how to examine their own practices using techniques that also work well with their students, they become experts in the inquiry process. As inquirers and problem solvers themselves, they are far more successful in modeling exploration and problem solving for students.

Time Lines

The ***MAP*** seminar takes place for a period lasting from three to six months. Seminar meetings are held as often as teams consider necessary, at a space to be determined in each school. Groups may choose to convene occasionally in colleagues' homes or in other informal meeting places within the vicinity of the school.

A typical time line for a semester-long seminar follows:

Month 1 — Discuss with seminar members the rationale for the action research project and the following goals:

- To implement teacher-directed analysis and planning of the school's mathematics program;
- To expand teachers' awareness of the new NCTM *Standards* and the characteristics of successful middle-grades mathematics programs;
- To strengthen collaborative relationships among mathematics teaching peers in participating schools; and
- To design a school-developed action plan for improving the mathematics program in participating schools.

Seminar members review the MAP Criteria for Excellence and accompanying Ideals in Section I of this guide. As a group, they conduct the Self-Assessment Inquiry and reach a pre-assessment consensus on how consistent they believe their school's mathematics program is with the MAP Criteria and accompanying Ideals.

Month 2	Seminar members learn to use the Mathematics Classroom Observation and begin observations.
	Conduct observations.
	Plan and schedule seminar meetings to discuss observations.
Months 3	Meet periodically to discuss teachers' reactions to the observation process and to other information gathered using selected assessment tools.
	Each participating teacher completes the agreed upon number of observations of colleagues' classes.
	Seminar members summarize the data they gather from observations.
Month 4	Seminar members analyze the results of the observations and other available data to evaluate the consistency of the school's program against the Criteria for Excellenc:
Month 5	Seminar members write an action plan for mathematics program improvement.

Seminar Leadership

MAP action research is coordinated at each school by a teacher leader or several co-leaders who serve as the project's on-site facilitator(s). Seminar leaders keep in close contact with the school's principal and curriculum staff, as well as with the school district's mathematics personnel, to obtain needed logistical support and funding. All guidelines and materials needed to conduct a seminar are found in is volume.

Additional Resources

It is helpful if the school or district can fund substitutes so teachers can observe one another and, occasionally, conduct more lengthy meetings to analyze data and complete an action agenda for improvement. In addition, consultants from a nearby university or from the district's mathematics department can also be invited to contribute to the process. Upon request, they may be able to suggest a wide range of resources, materials, and innovations that are new to teachers who are less familiar with the national press for improvement in mathematics education.

Beginning the MAP Seminar

A school's mathematics leadership begins a *MAP* seminar by distributing the materials in this booklet to interested colleagues. Start by encouraging colleagues to read Section I to obtain an overview of the *MAP* philosophy and Criteria and Ideals. Then, convening in seminar, review the directions for implementation in Section II, agree upon procedures for implementation, and begin the process. Sections II through V provide detailed instructions for conducting each phase of the assessment.

Section I

Characteristics of Successful Middle-Grades Mathematics Programs: Criteria for Excellence

Characteristics of Successful Middle-Grades Mathematics Programs

CRITERIA FOR EXCELLENCE

[Note: This article is adapted from the original essay, written for the CATALYST Summer Institute, that appeared in the pilot edition of the ***Mathematics Assessment Process for the Middle Grades (MAP)*** *Summer, 1990.]*

Mathematics always seems special. For some teachers, mathematics is a pleasure to teach because it is precise. The answers are either right or wrong; the tasks appear straightforward. Students always know where they stand, and the subject proceeds in a rational, logical way. Comfort lies in the progression from one mathematical idea to the next. Students learn to build ideas logically and to move step-by-step from concept to concept.

For other teachers, the enjoyment in mathematics teaching is in the excitement of discovery. They encourage students to find patterns, to apply what they do to their own lives, to explore the subject in many different ways. They consider mathematics to be patterned and logical, but not necessarily linear. If students discover an intriguing pattern, with their classmates they explore it to decipher its structure and understand its usefulness. Students learn to look for meaning and to connect mathematics with their own lives, generating theories and testing them in real ways.

Young adolescents who have mathematics teachers such as these are lucky indeed. These teachers are drawn to their work, committed to teaching a subject that stimulates their curiosity and interest--one they find personally involving and challenging. It is important that our schools support and help teachers with this kind of spirit about teaching mathematics, those who want to reach out to their students and to inspire them. Teachers like these could have made a difference for a mathphobic adult recalling her early mathematics experiences, who writes:

> *I happily spent hours on my homework. [Math] was a game...the processes were the unravelling of the [mystery], the motives, and the "whodunnit." Unfortunately, when I took my work to the classroom I quickly discovered that my solutions to the mysteries were incorrect, done with the wrong processes.*

Imagine how much more successful this student would have been if a teacher had been able to harness her imagination to find ways of seeing whether her "mysteries" followed mathematical rules! Often the right/wrong aspect of mathematics is daunting to students who are bright, interested, and somewhat impulsive. This is because we fail to help students learn that mathematics can make sense to them.

The goal of all mathematics education is mathematical literacy--fluent, appropriate understanding of mathematical information in new and previously unfamiliar contexts. This is essential to young people's healthy intellectual and personal development, as is the fluent use of other expressive communication forms. Just as we expect literacy in reading and writing, we want young adolescents to be mathematically literate as well.

What goes wrong in mathematics for so many children by the time they reach the middle grades? The answers lie partially in what we typically call "school mathematics," a specialized program of studies that has become largely separated from the mathematics from which it emerged. In school mathematics students rarely encounter the experience of using mathematics as a practical tool. Rather, they learn that mathematics is a set of procedures, disconnected from everyday life, to be followed simply to get answers to abstract numerical problems and equations. They rarely discover why those procedures might be important, nor do they understand what the procedures mean.

Mathematics is a language--a language used to communicate about a specific domain of human experience. Numbers and other symbols are the written language of mathematics. The earliest experiences that young people have manipulating such mathematical ideas as shape, form, size, quantity, volume, weight, time, and distance are represented in words, not symbolically. Small children compare sizes and shapes and talk about real things that are heavy, light, near, and far. When school mathematics begins, however, symbols are typically used very early, often too soon. Terms are defined and abstract examples are presented in the form of exercises that follow age-old rules. Ideas are explained rather than experienced, and students quickly move to the manipulation of symbols that stand for complex ideas, skipping the critical experience of discovering and debugging their own theories for why the symbols and rules work.

One of the problems facing mathematics teachers is imbuing symbols with meaning for children. Like premature teaching of sound-symbol relationships in reading, the too-early teaching of mathematical symbols, separated from their concrete, real-world meaning, profoundly affects a child's later learning of mathematics by depriving the child of confidence in being able to understand mathematical symbols. Effective mathematics relies on steadily, gradually accumulating understanding of meaning--in a context that makes sense to the developing child--whether that child is seven years old, trying to master telling time, or twelve years old, confronted for the first time with algebraic equations based on poorly-understood arithmetical operations.

Errors are treated very differently in language arts than in mathematics. When young children learn to talk, they make errors as their language develops, and these are warmly accepted as signs of intelligence and progress in language learning. They invent spellings as they learn to write. Parents and teachers are comfortable with these language developments, and do not generally pounce on children to overcorrect them. This is not so for mathematics.

Children's mathematical "miscues" are errors seen as serious, and are often overcorrected. We forget that, as with language learning, children's mathematical errors are based upon their own original theories. In time, mathematical theories, like those in language, will prove to be mistaken, forcing children to adjust them as they strive to match more accurate and workable cognitive models. If we would credit the mathematics structures that children develop as educated predictions and afford them the opportunity for self-correction (as we do in language and reading miscues), we would go a long way towards reaffirming children's natural mathematical competence and inventiveness.

Mathematics is a language with both symbols and meaning that was developed to communicate complex ideas. Although students are taught the grammar of mathematics, they do not often use it in schools to communicate ideas. This is especially true during the middle years. As mathematics becomes increasingly symbolic, it is important that teachers treat mathematical ideas as discussion points and use them with students as the source of important mathematical observations and theories. Middle graders who share and collaborate with each other, who debate and discuss their mathematical discoveries, learn to write and speak mathematics as a natural refinement of their first language literacy. The ability to communicate about and with mathematics is especially important during the middle years when developing young adolescents value and need intensive personal interactions with peers, adults, and with events and objects in their world.

Criteria for Excellence

Criteria for excellent mathematics programs are well documented, but these standards are complex, and school organizational structures and curricula have been slow to adjust to the changes. The technological innovations of the past several decades have brought about an upheaval in the way we learn, live, and work. Ironically, in the field most responsible for this dramatic change in our lives--mathematical science--schools have been slowest to modernize.

The *Criteria for Excellence* are built on a solid foundation of research and practice. Each Criterion is described by a set of six to eight Ideals that exemplify successful mathematics teaching in middle grades schools. The nine Criteria are explained more fully below, with a brief portrait of typical classrooms whose instructional program is characteristic of each. Since there are various approaches to meeting the Criteria, a number of rich classroom practices meet the same standards, although they may look quite different.

A complete list of the Criteria and their accompanying Ideals follows in the Appendix.

A. *Curriculum*

An effective middle-grades mathematics program uses a problem-centered curriculum to develop students' conceptual understanding of mathematics, appreciation for its applications, and proficiency in computational skills.

Mathematics education often seems to be a battle between proponents of conceptual understanding and those favoring arithmetical computation. It is not necessary to choose between them, however. The best mathematics programs incorporate both elements in their curriculum, assuring that students can compute well and that they understand what they are doing and why. If students do not understand, they cannot apply what they learn to new or unfamiliar situations. If they cannot compute, they cannot quickly assess the appropriateness of a calculator's answer to a string of operations. Mathematics programs can quite successfully incorporate both elements, developing both abilities, and having each reinforce the other.

The middle-school years are critical ones for learning mathematics, setting the foundation for the more abstract high school program to come, as well as for the mathematics students will have to know and use as adults. Students at this age welcome new material and, with the proper support, are very receptive to new learning challenges. Their rapidly developing cognitive abilities allow them to work on an increasingly symbolic level, but they are still most successful when they can attach symbols to meaningful real-life experience.

Repetitive review connects young adolescents to earlier school years and is considered boring, no matter how necessary it seems to adults. Often the review and consolidation of previously learned skills can be done in practical contexts, applying previously solidified skills to new knowledge and interests. New mathematics content represents an important chance for students to prove to themselves and to show their peers that they can master interesting and challenging new work.

An integrated middle-grades curriculum that relates various disciplines has a good chance of reinforcing the critical thinking skills that are blossoming in early adolescence. A study unit focusing on data analysis could combine science content with mathematical data analysis skills, and present new materials with familiar content or familiar skills in new content areas. Instead of having two separate subjects, students can collect and analyze data that compare students' general health and their eating habits, looking for patterns in the data--differences among families with certain demographic characteristics--and trying to analyze trends in eating and its effects on health, as scientists do.

In such an integrated curriculum, the emphasis would be on mathematical processes as well as science content. It is a challenge for middle-grades teachers to develop such a balanced curriculum; one that contains the independent mathematical skills (e.g., addition, multiplication, finding common denominators), as well as broader mathematical processes (e.g., estimation, problem-solving, evaluating information). A curriculum that focuses firmly on establishing a context for its mathematical work and is committed to applying developing skills will go far in preparing students for a successful mathematical future.

Imagine, for instance, a middle-grades curriculum on flight. Students begin their study by building paper airplanes, drawing the structures they have created, measuring the parts, and analyzing the aerodynamics of the way their planes fly. They review area by finding the area of the wing of the plane, comparing the ratio of flight distance to wing area as planes change in size and form. Graphs of data make such comparisons easier. Computer spreadsheets and calculators make the computations faster. Other variables are considered as students look for relationships, and the unit culminates with a visit to a nearby airport to talk with technicians and pilots about the variations in the capacity and behavior of airplanes with different features. In such a study, students can integrate knowledge of science, social studies, engineering and design--and are conducting genuine exploration of a topic that is not intended to become "mastered," but, rather, to provide ways of developing knowledge and exploring relationships among many pieces of information.

B. *Learning Experiences*

An effective middle grades mathematics program engages students in a variety of learning experiences designed to promote mathematical exploration and reasoning.

Young adolescents are rapidly developing the capacity to study their own thinking. Such self-understanding goes a long way towards helping them learn most effectively. The growth that occurs during these years in "metacognition"-- the ability to think about one's own thinking processes--is fundamental to students' capacity to analyze their mathematical understanding, developing and expanding their mathematical knowledge. As students move toward increasingly symbolic work, they become able to examine their own imagery and the assumptions they have made about numerical and geometric domains in mathematics. As a result, students are eager to talk with each other about their methods, comparing their understanding with that of their peers.

A variety of learning experiences supports students with a wide spectrum of learning needs and learning styles. During a teaching day, different mathematics classes might work with algebra tiles, multibase blocks, computers, protractors and rulers, tape measures, videotapes, paper and pencil, or small group project work and discussion. Teachers might use more than one material or approach during a class period. For too many young adolescents, concrete materials are not being used in mathematics classes. Yet the fullest progression of their thinking requires that they construct their own concepts, test their observations against the behavior of real objects and debate with peers about their alternative explanations and observations. Unfortunately, until recently, middle-grades students have been pressured to abandon their needs for concrete experiences prematurely. This balance between the concrete and the abstract is a key element in young adolescents' growth. Concrete models serve as essential contributors to building bridges between symbolic and concrete understanding.

Calculators and computers free students from diverting computational drudgery. These machines allow students to separate their understanding of processes from their computational ability or inability. The number-crunching power of these machines can help students as they become skillful in working with numbers in an assortment of other ways. The computer can provide a great deal of practice in writing formulas (using spreadsheets), in logic (constructing data bases), and in data analysis (graphing).

All of these are interesting and appropriate uses of sophisticated technology with young adolescents. Mathematical understanding can be the center of a seventh-grade measurement unit. Students can construct a model of a regulation-size soccer field, basketball court, or baseball diamond (depending on the groups' favorite sport or the season). They can then decide the equipment they would need to build the appropriate field, where they would turn to purchase it, and project the costs. In order to solve these problems the students work in groups, doing research, designing, drafting, and building the model and detailing estimates and cost projections.

It can take months of steady progress to accomplish such a project, and in the process students use the computer, calculators, tape measures, as well as blocks and other materials to construct scale models. If they are working on a sports field that the school does not currently have, they could present their models and cost projections to the principal and, ultimately, to the school board, as an argument for a modification in the school plan. The discussions and debates carried on in the small groups, in the larger class sessions, and finally, with school officials are instrumental in increasing students' capacity to put ideas into words, to make sound and practical arguments and judgments, and to collect and analyze information. Numerous mathematical skills are enhanced. More importantly, however, students become sensitive to the challenges of creating something meaningful to them, the creativity, planning, and costs involved, and the skills needed.

Through this real and relevant problem, students develop their increasingly complex and sophisticated mathematical processes and explore their own approach to learning. The most effective middle grade mathematics programs help students develop understanding in both these areas.

C. *Problem Solving and Critical Thinking*

An effective middle-grades mathematics program develops students as problem solvers, critical thinkers, and effective communicators in mathematics.

The long-term goal of any school mathematics program is to prepare students to think flexibly about mathematical problems and to intelligently deploy a complex array of skills in their solution. Reflective and critical thinking is essential as students solve mathematical problems in school. Without significant classroom discussion of problems and their various solutions, sessions on problem solving become exercises in "numerical target practice," as each student vies to be the first done with the "correct answer."

Mathematics teachers who effectively develop students' problem-solving skills spend a great deal of time in discussions, speculating about solution strategies and evaluating and implementing alternative approaches. The teacher's critical role is to facilitate the discussion, encouraging alternative statements and comparative methods, coaching those who have not yet captured the concepts. Because being confused is a useful part of problem-solving, adequate time is provided for the resolution of such confusion. This is especially important for young adolescents who face uncertainty in so many dimensions during these years. They need the kind of encouragement that validates their confusion, helping them see that it is a normal, indeed, a valuable stop on the road to real understanding.

Experience is vital to becoming effective mathematical problem solvers. Students need to spend school time solving real-world problems and examining their interrelated applications. Most middle-grades textbooks have problem-solving assignments that are oversimplified or hypothetical pieces of a complex reality. We do our students a disservice by cutting their world into unnatural but apparently bite-sized pieces. Problem situations need to involve richness and complexity so that students easily transfer their problem-solving skills.

As part of this effort, teachers encourage students to devise solution strategies by rewarding students' creative and promising approaches, even when those do not yield a correct answer. When alternative solutions are accepted and seriously investigated, regardless of their text-centered "correctness," students learn to take their own thinking seriously and to evaluate the results they obtain by using critical thinking. What does the answer to the problem mean? How was it arrived at? Could there be alternative strategies for arriving at the same solution? Are there alternative solutions? Can this be extended to other problems? In what ways? Questions such as these allow students to find meaning beyond the specific example, and to evaluate the results of their work.

Students enjoy being actively involved in problem solving, inventing problems themselves, discussing their solution strategies, debating possible approaches, evaluating the results of their work, and generating their own heuristics. Effective teachers of problem solving model the process; they engage in it along with the students and enjoy its twists and turns.

D. *Diverse Needs*

An effective middle-grades mathematics program provides instruction and resources to meet young adolescents' diverse learning needs.

Young adolescents have a multiplicity of learning needs. Because of the range of cognitive and emotional levels that are present in any middle-grade classroom, it is important that schools support such diversity with a rich array of teaching approaches, content selection, materials, and learning environments. The developmental range of middle-grade students' experience and achievements challenges teachers' patience, equanimity, and creativity during these years.

A complex interaction between social uncertainty and personal values may lead students with unexplored talent and potential for success in mathematics to avoid courses in the field, therefore closing out many later career options. In particular, the failure rate in mathematics for girls and minority students has been historically so high that their absence from the pool of potential users of complex mathematics threatens the economic well-being of our country. Typically, female or minority students who enter middle grades as relatively high achievers in mathematics find themselves slipping to ever lower levels during these years. Peer pressure, unappealing content, lack of role models and parental encouragement conspire to discourage the interest of many otherw . able students.

Effective middle-grades mathematics programs are structured to prevent such patterns from developing. Students are supported and coached to tackle hard problems, and they do well. School tasks are not oversimplified, so students' genuine interest and capacity are engaged. They gain a repertoire of effective coping mechanisms, and develop a solid foundation for knowledge and strategies that stand them in good stead for later mathematics. We know that effective middle-grades schools challenge all their students and have high expectations that each will demonstrate competence and achievement. These high expectations disregard irrelevant demographic variations, and use students' uniqueness as an instrument for success.

Like all young people, middle-grades students rely for their security on the clarity of a dependable structure and knowledge about where the limits are. Their mathematics learning environment must include clearly stated policies about classroom expectations, procedures, homework policies, and how students' learning will be assessed. When students know their work has some real value, they respond well to the structure and to demands placed on their behavior.

Homework holds special potential for rich learning during the middle years. Now older and able to move more independently around the community, students' out-of-school assignments can enable them to participate in their neighborhood and town. Students can become part of a community project, collecting and interpreting data about using a park across from the school. This participation begins in the classroom, where the mathematics curriculum strengthens young adolescents' sense of efficacy.

Opportunities for exploring and defining who they are as individuals--learning how a solid grounding in mathematics is part of that growth--are essential components of a program that promotes young adolescents' healthy development. As students project themselves into a future that they can begin to imagine with increasing clarity, they need to bump up against their own skills and limitations. Effective mathematics instruction can help students observe themselves as they try new experiences. By monitoring their developing skills, applying them against new challenges, they can make a realistic appraisal of their own learning needs, styles, and preferences. Mathematics, because of its ability to model problem solutions and strategies, allows students to see possibilities without having to decide on those that are superior. Recognizing that mathematics is a "critical filter" to many careers is a vital piece of this knowledge. In learning to develop positive social interactions with both peers and adults, many effective middle-grade schools are basing large pieces of the mathematics curriculum on collaborative learning. In early adolescence, students become self-conscious. The threat, however unlikely, of making a mistake, however trivial, is daunting. Many students will not willingly answer questions or volunteer information, much less ask questions of the teacher. The fear of appearing not to know is too risky.

For these reasons, collaborative learning is a way both to diminish the fear of individual attention and to validate student discussions of important ideas with peers. Enabling students to translate mathematical symbols and logic into language, and in turn, to translate verbal logic into mathematics uses students' emerging capacity to use language abstractly.

Physical activity is also a need of young adolescents. Their bodies are changing more dramatically than at any other period in their lifetime. They will grow during these years to 98 percent of their adult size, thus generating a tremendous amount of energy. Teachers who take advantage of this energy routinely find ways to encourage their students to move about the classroom and to engage in activities that take them throughout the school. Active data collection, project planning, and the creation of physical models help focus some of this energy and build upon the intrinsic nature of the learner. Providing both support and stretching for the young adolescent is the very nature of an effective middle grades mathematics program. The range of student needs makes this both challenging and rewarding.

Finally, the emerging cognitive capacity and greater involvement with an expanding social world makes young adolescents increasingly aware of the judgments and opinions of others. Thus, if the mathematics program is to find ways for students to understand their mathematical learning potential, it must avoid labeling and sorting students into permanent groups. When growth and potential are so dynamic, labels--many of which have negative implications--are inappropriate and pernicious. Often they establish in students inappropriate self-images from which they never fully recover. Tracking, assumed by parents and teachers alike to be necessary for students, is counterproductive for the students it is most intended to serve. In fact, most students can learn best if at least part of their mathematics program is conducted in mixed ability classes. The evidence is indisputable that being labelled in early adolescence can have lifelong negative consequences.

Every year, students are lost to higher mathematics classes and to careers in many fields because they internalize negative images of themselves as mathematics students. An effective middle grades mathematics program capitalizes on the diversity of the student body. Acceptance of diversity, encouragement of alternative approaches to problem solving, and recognition of inventiveness and thoughtful intuition rather than simply "answer getting," are mechanisms that allow students at all achievement levels to learn that they can be achievers too.

E. *Attitudes*

An effective middle-grades mathematics program fosters positive attitudes about mathematics and encourages and recognizes students' accomplishments.

Early adolescence is a major gateway in the human life cycle. At this juncture, positive interventions, rewards, and recognition can powerfully affect young people's healthy development. Mathematics becomes attractive to students during these years when students see that mathematicians are respected and significant contributors to their world. By learning about appealing role models in mathematics-related fields who share their ethnic or racial uniqueness, students find reasons to pursue mathematics.

Moreover, through their own accomplishments in mathematics, students test the limits of their potential. The satisfaction they gain smooths their adaptation to adolescence, helping to offset temporary setbacks and disturbances of self-esteem that may occur. In classrooms that provide the time to finish extended mathematics-related projects, students can learn to create attractively presented computerized drawings, spreadsheets, or constructed models, experiences that enable them to experience a sense of pride about their mathematical accomplishments.

Competition is especially exciting for some, but not all, students during this period. By having choices about whether they work individually or in groups, all students have an opportunity to be part of a mathematical success story that is acknowledged publicly. That is, all may compete successfully. Displays of student work in the classroom and school hallways or in businesses or public buildings within the community can be sources of great pride for students and families alike. Confidence increases when students serve as leaders in mathematics competitions and science projects, or tutor young students who are just learning the mathematics that is routine for middle-grades students.

Many ways can be found to recognize students' achievements in a wide variety of mathematical activities. Students may design an effective plan for building a track, a game room, or a greenhouse for the school; they may develop a statistical study of the demographics of the student body and the community; they may write essays describing experiences in a mathematics class; they may help out with a fix-it project at home involving elaborate measurements. In pursuing mathematics in diverse contexts, students see that their contributions are real, they recognize that their contributions are appreciated, and significantly, they learn how mathematics is relevant to themselves and to their community.

F. *Relevance*

An effective middle-grades mathematics program relates mathematical knowledge to students' interests, experiences, and future goals.

Middle-grades students seek a strong sense of efficacy and purpose. Collaboration in activities that use mathematical knowledge fosters important linkages and friendships among students and with adults, and enables young adolescents to discover for themselves how mathematics is integrated into the routines of many adults, both on and off the job. Possibilities for action projects in mathematics are numerous: building a neighborhood center; planning a camping trip or journey out of state; participating in a home building or home repair project; computing the average cost of the wasted food in the school cafeteria and figuring how many homeless people this amount of food could support. Projects like this last one have the additional benefit of bridging the gap between school and community. Real problems are the best contexts within which to conduct mathematics investigations and explorations.

Through community service students also discover role models that go beyond those in the immediate family, expanding their horizons, teaching them new skills, and allowing them to test alternative visions of themselves and their futures. Although many middle-grades students have no firm idea about future careers, they can become fascinated with the prospect of learning about occupations. The idea of adulthood is simultaneously distant and close. Too seldom do middle-grades students--especially young women and minority students--see adults like themselves who work in the sciences or use mathematics. Opportunities to think about the ways in which mathematics might relate to careers in which they are interested are vital. Experiences that bring adults into the schools and, in turn, allow students to enter the world of work are deeply important, especially when minorities and women are the workers who are using mathematics in their careers.

G. *Faculty*

An effective middle-grades mathematics program inspires collegiality among faculty who work together to implement responsive programs for young adolescents.

The interactions of the faculty in a school have a powerful effect on students and on their mathematics program. Faculties that help one another also help their students. Furthermore, knowing that their work matters and that they are supported by peers are positive forces in the intellectual lives of teachers.

Such adults, in turn, positively influence students and the school community in general. The faculty's knowledge about young adolescent development and their prior experience with the age group creates a context for making collegial decisions about program planning. When there is an open exchange of ideas and competition is minimized, a faculty is most successful in working together. Meetings, classroom visitations, and participation as workshop leaders and in professional meetings are the intellectual glue for the department. Excitement about the students' achievement in the school's mathematics program forms a strong bond that sustains growth and change.

Students need to feel that the adults who work with them are a team who respect each other, plan student work with a deep commitment to and concern for students' interests and welfare, and communicate with each other often and with pleasure. Such a healthy partnership models a process that students need to learn to promote their own success. Through participation and collaboration young adolescents can find school a safe place to be.

H. *Parent and Community Involvement*

An effective middle-grades mathematics program involves parents and the community in a collaborative effort to promote student competence in developing and using mathematical knowledge.

Mathematics is a field that is deeply affected by parental attitudes. If parents have never felt successful in mathematics, they may not be able to help their children in doing homework and making course choices intelligently. Parents who concentrate on their own mathematical weaknesses affect their children's attitudes about themselves and their potential. In this area, outreach and public relations that stress the benefits and accessibility of mathematics are vitally important. In school, projects and home assignments that involve the family in real mathematical experiences or relate the events of the mathematics class to the ongoing life of the community are very important to convincing parents that their young people have positive potential as mathematics learners.

Schools that interpret their goals to parents and provide information regularly about their mathematical programs involve parents as full partners in the mathematical lives of their children. Frequent classroom visits, before-school breakfasts, evenings of "family math," and shared home-school projects allow students and parents to understand themselves and each other as learners and as people. Community-focused activities can, similarly, inform and involve the broader community about the goals and the activities associated with middle-grades mathematics education.

When parents receive information they become interested and, in time, the walls of the school become permeable. This works to everyone's benefit, spreading the story of the effectiveness of the middle school mathematics program and bringing interested participants into the school to share their talents, their vocations, and their appreciation for mathematics in their worlds.

I. *Assessing Progress*

An effective middle-grades mathematics program continually assesses student achievement, evaluates program effectiveness, and uses the results to determine the need for improvement.

Assessing student achievement and its relation to program evaluation is a key element in an ongoing program evaluation process. Student test scores are but one **limited** index of understanding and involvement in mathematics. Program monitoring must encompass many elements.

In one middle school, teachers became concerned with their program when they noticed that the school's high test scores on the California Achievement Test were not sustained by the Scholastic Aptitude Test results later published in the local newspaper. They also noted that the scores were much lower in mathematics for girls and minority students. Finally, and most seriously, teachers did not see evidence in students' daily work that their mathematical thinking was reliable or applicable to nonroutine problems and practical contexts.

Investigating these phenomena, they found that girls and boys alike have limited experience applying their mathematical ideas to real-world tasks or in new mathematical contexts. While standardized tests indicated that student mathematics achievement in the elementary grades was satisfactory, by the time these students reached middle and high school, they seemed to have little idea of how to use their mathematical knowledge. A closer look also revealed that while minority students were integrated into the regular program until the fifth grade, the school's standardized test-based procedure for grouping students in the middle grades reduced the number of minority and limited-English students in higher-level mathematics classes.

Appropriate assessment of the mathematics program requires using evaluation and assessment tools that go well beyond standardized tests. It includes recognizing trends in standardized test scores both in the school and in the nation. But, more important, comprehensive strategies for assessing student mathematical progress requires they demonstrate their mathematical knowledge in a myriad of contexts such as: creating models and demonstrations of mathematical ideas, writing mathematical conjectures, theories, and solutions, and varying how they apply their mathematical thinking to practical contexts. Portfolios of students' routine work becomes the most practical record of individual growth and achievement.

Further monitoring practices may take the form of formal or informal needs assessments conducted on a regular basis. Cyclical analyses of the effectiveness of the curriculum engage the faculty in the evaluation of their program as a routine matter. In one large school district, the assessment routine includes specialized needs assessments, planned curriculum revisions, and two-year experiments with innovations, followed by clear, positive evaluations before program changes are adapted across the district. Standardized test data are de-emphasized in favor of closely examining student portfolios of mathematics work, group projects, and the regular writing students do to explain their mathematical thinking. In addition, interviews with randomly selected students, parents, and teachers, adds to the data base used to routinely upgrade and revise the overall curriculum offerings.

Moving Toward Excellence

The *Criteria for Excellence* in middle grades mathematics provides schools with a standard against which to examine their own mathematics program. Seeking out program strengths and weaknesses, through a fluid, comfortable exchange among colleagues, peers, and allies in the teaching venture, enables teachers to determine ways their programs can better match their students' needs. Such an exploration allows teachers to respond constructively to society's changing demands for a different, more vibrant mathematics program.

The ultimate goal is to inspire the mathematical talents among young people during their middle-grades years, encouraging them to fulfill their potential for mathematics and scientific achievement. In this way, Americans can turn with confidence to today's generation, assured they will sustain and advance the rapid scientific and technological developments achieved by their parents and grandparents.

The Criteria for Excellence establishes a vision. In various ways, schools can collect data and use the information they gather to reflect on their mathematics program. After looking at a school's mathematics program within the context of this vision of excellence, there will likely be many things schools will want to keep as they are, but there will also be some things they will feel certain need changing.

In the flurry of reports, mandates, and "standards," it is often difficult for teachers to determine what they value about the mathematics program they have evolved, and what they genuinely want to change. The Criteria for Excellence is a tool teachers can use to begin to bridge the gap between reformers and teachers, putting into teachers' hands a vision of what can be.

 The project directors wish to thank Rebecca Brown Corwin, Lesley College, who collaborated in writing this section.

Modeling
Mathematics
Teaching
Excellence

CRITERIA FOR EXCELLENCE AND ACCOMPANYING IDEALS

An effective middle-grades mathematics program:

A. Content

Uses a problem-centered curriculum to develop students' conceptual understanding of mathematics, appreciation for its applications, and proficiency in computational skills.

1. The curriculum provides a problem-based context for learning.
2. Mathematics problems occur in varied formats.
3. The curriculum content is balanced and comprehensive.
4. The curriculum develops number and operation sense.
5. The curriculum develops spatial and measurement sense.
6. The curriculum includes probability and statistics.
7. The curriculum introduces algebraic notions of variables, equations, and functions.
8. The curriculum emphasizes understanding of concepts and procedures.
9. The curriculum is research-based and responds to a changing society.

B. Instruction

Engages students in a variety of learning experiences designed to promote mathematical exploration and reasoning.

1. Students actively engage in mathematics.
2. Students discover meaning through manipulations with concrete materials.
3. Students learn individually and in groups.
4. Students construct meaning using a variety of resources and instructional materials.
5. Instruction makes appropriate and regular use of technology.
6. Instruction balances new learning and review; classwork and homework.
7. Supplementary programs and enrichment activities extend mathematics instruction beyond the classroom.
8. Homework extends mathematics learning and applies new study skills.

C. Thinking Processes

Develops students as problem solvers, critical thinkers, and effective communicators in mathematics.

1. Thinking processes reflect multiple strategies for problem solving.
2. Teachers model problem solving.
3. Students pose problems and discover solutions.
4. The curriculum develops analytical reasoning abilities.
5. Students and teachers discuss mathematical ideas.
6. Students write and talk with one another about mathematics.
7. Teachers clarify underlying concepts and listen to students' ideas.

D. Developmental Diversity

Provides instruction and resources to meet young adolescents' diverse learning needs.

1. All students, especially minorities, girls, and developing English speakers, have equal access to information, assistance, and classroom interaction.
2. Teachers use fair and flexible grouping practices.
3. Teachers accommodate special needs, abilities, and disabilities.
4. Teaching strategies motivate underachievers.
5. The classroom environment invites participation by all students.
6. Staff development and planning focus on the unique developmental needs of young adolescents.

E. Attitudes

Fosters positive attitudes about mathematics and encourages and recognizes students' accomplishments.

1. Teachers believe all students are capable of mathematics achievement.
2. Students believe they can be successful in mathematics.

3. Students help develop high expectations and standards for themselves and others.
4. The school recognizes and rewards the mathematics achievements of all students.
5. Originality and accuracy in mathematics are both rewarded.
6. Students are free to make mistakes and are encouraged to take risks.
7. The school encourages families to expect and support mathematics achievement.
8. School support personnel (counseling staff, media specialists, etc.) assist in promoting the mathematics program.
9. The community values mathematics achievement.

F. Relevance

Relates mathematical knowledge to students' interests, experiences, and future goals.

1. Teachers relate mathematics to individual interests.
2. Imaginative uses of mathematics are stimulated.
3. Mathematics is applied to the arts and sciences.
4. The usefulness of mathematics is taught across subjects.
5. The program stresses the importance of mathematics in everyday life and in future career choices.

G. Collegiality

Inspires collegiality among faculty who work together to implement responsive programs for young adolescents.

1. The mathematics program has strong leadership and an effective, knowledgeable, and caring staff.
2. The school and district support teachers' continuing education in mathematics.
3. The mathematics department conducts regular program reviews and plans in-service activities.
4. Interdisciplinary collaboration strengthens mathematics teaching.
5. Administrators encourage professional involvement.
6. Schedules enable collaborative planning.

H. Community

Involves parents and the community in a collaborative effort to promote student competency in developing and using mathematical knowledge.

1. Parents and community are involved in improving the mathematics program.
2. Parents are informed about the development and purposes of the mathematics program.
3. Parents are informed of specialized support and instructional assistance in mathematics.
4. Parents are informed of mathematics curriculum options and their consequences.
5. Parents and community participate in mathematics activities in and outside of school.

I. Continuing Assessment

Continually monitors student achievement, evaluates program effectiveness, and uses the results to determine the need for improvement.

1. Individual student achievement is evaluated using multiple sources of data.
2. Students and parents receive constructive feedback.
3. Assessment sources address school, district, state and national goals.
4. Grading policies are clearly defined and administered consistently.
5. The mathematics program is evaluated using multiple sources of data.
6. Teachers in all subject areas participate fully in program planning and evaluation.
7. The middle-grades mathematics program coordinates with the mathematics programs in local elementary and high schools.
8. The mathematics department monitors curriculum materials for bias.

NOTE: The Criteria for Excellence in Middle Grades Mathematics are based upon research in mathematics teaching and learning, the *Curriculum and Evaluation Standards for School Mathematics* by the National Council of Teachers of Mathematics, and research on the developmental characteristics and needs of young adolescent students. The framework was developed in conjunction with tthe *Mathematics Assessment Process for the Middle Grades* (1990 Pilot Edition) by staff of the CATALYST Project at the Center for Research in Mathematics and Science Education, North Carolina State University, Raleigh, NC. Contributors to the design include researchers from the Department of Mathematics Education at the University of Georgia in Athens, GA, and the Center for Early Adolescence, University of North Carolina at Chapel Hill. The authors of this framework encourage its use with acknowledgment of its association with the CATALYST Project.

Middle Grades Mathematics

Criteria for Excellence

Self-Assessment Inquiry

Use essment process as you begin thinking about and exan ıss of your school's mathematics program.

Liste ;ges are nine research-based Criteria for Excellence that chara ldle-grades mathematics programs. Within each criterion are a list of ideals -- practices which define each criterion. The pre-assessment of your school's mathematics program is conducted by reviewing and discussing each ideal and asking the question:

How consistent is our current mathematics program with this ideal?

Additional information about interpreting the Criteria and Ideals can be found in the accompanying essay, **Characteristics of Successful Middle-Grades Mathematics Programs: Criteria for Excellence.**

Instructions

Read and decide how closely you think the school's mathematics program meets each ideal. As you evaluate the status of the mathematics program, indicate next to each ideal which one of the following best applies:

C The school's mathematics program is **consistent** with this ideal.

I The school's mathematics program is **inconsistent** with this ideal.

U I am **uncertain** as to whether the school's mathematics program is consistent or inconsistent with this ideal.

After all your colleagues have completed this process on their own, the entire mathematics team convenes in a seminar. The purpose of the meeting will be to *reach a unified understanding of each ideal, debate the different viewpoints, and come to a consensus about how well the current program meets each ideal.* While individuals may wish to refer to their original lists, keep in mind that this is a discussion of ideas, not a tally or a vote.

This process is used only to familiarize teachers with the Criteria for Excellence and to initiate the collegial sharing of ideas. The discussions and the data gathering during seminars that follow will verify the team's hunches about its mathematics program and will eventually guide action planning for overall improvement.

The team facilitator will retain the group's consensus and submit a copy to the MODELS project staff for later reference.

Middle-Grades Mathematics
Criteria for Excellence

Our School's Mathematics Program . . . .

A. CONTENT

Uses a problem-centered curriculum to develop students' conceptual understanding of mathematics, appreciation for its applications, and proficiency in computational skills.

___ 1. The curriculum provides a problem-based learning context.
___ 2. Mathematics problems occur in varied formats and contexts.
___ 3. The curriculum content is balanced and comprehensive.
___ 4. The curriculum develops number and operation sense.
___ 5. The curriculum develops spatial and measurement sense.
___ 6. The curriculum includes probability and statistics.
___ 7. The curriculum introduces algebraic notions of variables, equations, and functions.
___ 8. The curriculum emphasizes understanding of concepts and procedures.
___ 9. The curriculum is research-based and responds to a changing society.

B. INSTRUCTION

Engages students in a variety of learning experiences designed to promote mathematical exploration and reasoning.

___ 1. Students actively engage in mathematics.
___ 2. Students discover meaning through manipulations with concrete materials.
___ 3. Students learn individually and in groups.
___ 4. Students construct meaning using a variety of resources and instructional materials.
___ 5. Instruction makes appropriate and regular use of technology.
___ 6. Instruction balances new learning, review, and homework.
___ 7. Supplementary programs and enrichment activities extend mathematics instruction beyond the classroom.
___ 8. Homework extends mathematics learning and applies new study skills.

C. THINKING PROCESSES

Develops students as problem solvers, critical thinkers, and effective communicators in mathematics.

___ 1. Thinking processes reflect multiple strategies for problem solving.
___ 2. Teachers model problem solving.
___ 3. Students pose problems and discover solutions.
___ 4. The curriculum develops analytical reasoning abilities.
___ 5. Students and teachers discuss mathematical ideas.
___ 6. Students write and talk with one another about mathematics.
___ 7. Teachers clarify underlying concepts and listen to students' ideas.

D. DEVELOPMENTAL DIVERSITY

Provides instruction and resources to meet young adolescents' diverse learning needs.

___ 1. Students have equal access to information, assistance, and classroom interaction.
___ 2. Teachers use fair and flexible grouping practices.
___ 3. Teachers accommodate special needs, abilities, and disabilities.
___ 4. Teaching strategies motivate underachievers.
___ 5. The classroom environment invites participation by all students.
___ 6. Staff development and planning focus on young adolescents' needs.

E. ATTITUDES

Fosters positive attitudes about mathematics and encourages and recognizes students' accomplishments.

___ 1. Teachers believe all students are capable of mathematics achievement.
___ 2. Students believe they can be successful in mathematics.
___ 3. Students help develop high expectations and standards for themselves and others.
___ 4. The school recognizes and rewards the mathematics achievements of all students.
___ 5. Originality and accuracy in mathematics are both rewarded.
___ 6. Students are free to make mistakes and are encouraged to take risks.
___ 7. The school encourages families to expect and support mathematics achievement.
___ 8. School support personnel (counseling staff, media specialists, etc.) assist in promoting the mathematics program.
___ 9. The community values mathematics achievement.

F. RELEVANCE

Relates mathematical knowledge to students' interests, experiences, and future goals.

___ 1. Teachers relate mathematics to individual interests.
___ 2. Imaginative uses of mathematics are stimulated.
___ 3. Mathematics is applied to the arts and sciences.
___ 4. The usefulness of mathematics is taught across subjects.
___ 5. The program stresses the importance of mathematics in everyday life and in future career choices.

G. COLLEGIALITY

Inspires collegiality among faculty who work together to implement responsive programs for young adolescents.

___ 1.The mathematics program has strong leadership and an effective, caring staff.
___ 2.The school and district support teachers' continuing mathematics education.
___ 3.The mathematics department conducts regular program reviews and plans in-service activities.
___ 4.Interdisciplinary collaboration promotes mathematics understanding.
___ 5.Administrators encourage professional involvement.
___ 6.Schedules enable collaborative planning.

H. COMMUNITY

Involves parents and the community in a collaborative effort to promote student competence in developing and using mathematical knowledge.

___ 1.Parents and community are involved in improving the mathematics program.
___ 2.Parents are informed about the development and purposes of the mathematics program.
___ 3.Parents are informed of specialized support and instructional assistance in mathematics.
___ 4.Parents are informed of mathematics curriculum options and their consequences.
___ 5.Parents and community participate in mathematics activities in and outside of school.

I. CONTINUING ASSESSMENT

Continually monitors student achievement, evaluates program effectiveness, and uses the results to determine the need for improvement.

___ 1.Individual student achievement is evaluated by multiple sources.
___ 2.Students and parents receive constructive feedback.
___ 3.Assessment sources address school, district, state and national goals.
___ 4.Grading policies are clearly defined and administered consistently.
___ 5.The mathematics program is evaluated through multiple sources.
___ 6.Teachers in all subject areas participate in program planning and evaluation.
___ 7.The mathematics program coordinates with the mathematics programs in feeder elementary and receiving high schools.
___ 8.The mathematics Department monitors curriculum materials for bias.

Section II

Using the Mathematics Assessment Process for the Middle Grades (MAP)

MODELING MATHEMATICS TEACHING EXCELLENCE

Section II

USING MAP: Mathematics Assessment Process for the Middle Grades

The Assessment Framework

The *Mathematics Assessment Process for the Middle Grades* is founded on three central ideas:

- Widespread consensus exists among mathematical scientists and educational leaders about the mathematics middle-grades students need to prepare them for the technological world in which they are living. At the same time, neither the curricula recommended nor the appropriate instructional practices are widely used in middle-grades schools;
- Young adolescents can become accomplished mathematics learners and thinkers only in a context that understands and responds to their developmental needs; and
- A sound body of organizational theory and research offers strategies for planned change that can effectively guide the restructuring of school mathematics programs.

Through MAP, teachers explore the question, *"How well is our school meeting the mathematics education needs of our students?"* The process yields an action plan, developed by mathematics teachers, for updating elements of the mathematics program to make it more responsive to and effective for students.

MAP offers a realistic approach to mathematics program improvement. It does not impose an idealized model or set of standards upon the school. Instead, it involves the mathematics department in an evaluation that inspires improvement from within. The process is structured informally to maximize the opportunities for colleagues to conduct open dialogues with one another about critical mathematics teaching issues.

Initiating the Assessment: Clarifying the Vision

Planning any school improvement effort begins by clarifying the overall goals a community has for its students. It involves sharing a vision of the future in two ways:

- A united view of how the school's mathematics program will look in the future; and
- A carefully developed improvement plan to achieve the future vision.

MAP helps schools establish both.

The MAP Criteria for Excellence (see Section I) describe a research-based vision of a comprehensive mathematics program. As its acronym suggests, the assessment process is a road map to developing effective middle-grade mathematics programs for young adolescents.

The assessment and planning are undertaken in five steps, each of which are described in this guide.

- Pre-assessment
- Preparing to conduct MAP
- Using the assessment instruments
- Summarizing and analyzing data
- Action planning

The first three steps, from pre-assessment through data gathering, are described in this section. Assessment tools are provided in Section III. The procedures for summarizing and analyzing the data comprise Section IV. Section V describes action planning and implementation planning.

Pre-Assessment

The MAP Criteria for Excellence and accompanying Ideals are the starting point for developing the mathematics department's vision of its future. Members of the department convene as a team and begin their work by reading the background in Section I in this manual, *Characteristics of Successful Middle-Grades Mathematics Programs: Criteria for Excellence*. Working collaboratively, the group completes the accompanying Self-Assessment Inquiry.

The self-assessment offers team members the opportunity to discuss and examine in depth the MAP Criteria for Excellence. The discussion also reveals how different department members perceive the school's present mathematics program as measured against the Criteria for Excellence. The procedures for conducting this inventory are included in Section I.

Following self-assessment, a representative team of department members use the procedures described in this section, along with the information they select from the data gathering instruments in Section III, to document current practice. The data gathered with the instruments describe the status of the program and establish a baseline of information for developing an improvement plan that brings mathematics teaching in closer alignment with the Criteria for Excellence.

Preparing to Conduct MAP

The MAP instruments simplify data gathering and, at the same time, stimulate colleagues to match their own teaching approaches with the research-based MAP Criteria for Excellence. The instruments can be used without extensive training. The following pages briefly describe the assessment process and how to use the instruments.

Ideally, the assessment team includes all members of the mathematics department, although a sizeable subgroup can represent the whole. Assessment teams should meet to review the entire Implementation Guide and to select elements of the assessment instruments they plan to use, and to establish a time line for data gathering and action planning. The complete process can take from two to six months. The *Introduction* to this guide provides a time line for participants in the MODELS OF MATHEMATICS TEACHING EXCELLENCE project.

A team-appointed facilitator arranges and convenes meetings, and keeps meeting discussions and the overall process moving smoothly. The facilitator also serves as a contact person with the principal and other administrators. Although the school administration is not directly involved in conducting the assessment, its support is essential. Every effort should be made to keep administrators informed of the progress of the team's work.

At least one person in the mathematics department should act as a recorder for each meeting the group holds. In some cases the team will find it beneficial to share the recording role. Although it is not necessary to keep minutes for every meeting, the recorders will need to keep track of the data gathered and of the results of the team's discussions and decisions.

In preparation for conducting the assessment, team members carefully examine each of the instruments and raise any questions they have about how they are to be used. The group should resolve questions of procedure or interpretation among itself before it begins. Because this is an "insiders" project, all procedural decisions and questions of interpretation will be resolved jointly by team members.

The instruments are self-explanatory. They may be used whole or in part. Brief introductory remarks guide their use. Only the Mathematics Classroom Observation requires any specialized preparation.

These guidelines are designed to obtain an optimum amount of data for decision making. The assessment procedures should be adapted, however, according to the needs of the school. A focus on the goal -- designing an action plan on the basis of the Criteria for Excellence -- should be kept in the front of the team's thinking at all times.

Using the Assessment Instruments

Conducting Observations

Overview

The cornerstone of the assessment process is the classroom observation. Through observation, teachers develop an appreciation of the range of their colleague's teaching styles and learn more about the specific content they are teaching. By becoming aware of the contrasts in colleagues approaches to mathematics instruction, teachers can better coordinate their program with others' and, ultimately, they will strenghten the overall mathematics education provided to students. There are three specific purposes of the MAP observations:

1) *To determine the extent to which the teaching processes used in the school reflect the NCTM Curriculum and Evaluation Standards for School Mathematics and the* MAP Criteria for Excellence;

2) *To familiarize colleagues with each other's working styles and teaching methods; and*

3) *To document the positive practices team members currently use to teach mathematics.*

Since teams are seeking a comprehensive picture of their mathematics program, observations should occur frequently, over a several-month period. Each mathematics teacher should try to conduct enough observations to gain a broad perspective of the range of mathematic activities and styles their colleagues use. About ten observations over a two to four month period is an optimal number for a teaching faculty of six to ten members. Each observation period should last only about 15 to 20 minutes, or as long as it takes to record the activities and the context of each class segment observed.

Classroom observations are NOT designed to evaluate any individual teachers or their teaching. No information identifying specific individuals should be recorded. The Mathematics Classroom Observation form (provided in Section III) includes directions on procedures to following in conducting the classroom observations.

Teams will want to attend to a number of organizational details before the observation period begins. To begin with, the team should determine:

- The frequency of observations
- Observation schedules
- Logistics for covering classes of observers

Teachers should try to observe **all** colleagues--those they perceive to have very different teaching styles, as well as those with very similar approaches at least one time, and more often if time permits.

Learning to use the obseration instruments: Team members should spend at least one extended session practicing the observation process, using the observation form, and agreeing on how to interpret any items that are unclear. Observation practice can be conducted using videotapes of mathematics classes or by having members practice observing in one another's classroom in five to ten minute segments.

Working in pairs (or as a group, if using a video tape), team members should conduct five to ten minute practice observations. Following each trial, observer pairs or the team (if using a video tape) should review the items they marked and discuss any disagreements or questions about how to interpret ambiguous items. The practice concludes when team members reach agreement on how to interpret all observation items and are confident they are all using the MCO in the same way.

After observing a class, be certain to informally express appreciation to the person observed. You will almost certainly pick up good ideas or suggestions you can use with your own students. Be sure to share these positive experiences -- few people tire of praise or credit for a good idea!

A summary of suggestions for conducting observations follows in Figure II-2 at the end of this section.

Mathematics Teacher Interviews

Overview

The Mathematics Teacher Interview (MTI) and the Mathematics Classroom Observation are the basic data-gathering tools.

The interview includes 66 open-ended questions, each of which is keyed to one of the MAP Criteria for Excellence and accompanying Ideals. It is designed to be used to promote an exchange of ideas among colleagues. It can be conducted, in its entirety or in part, either individually or in a group. Through the MTI, teachers engage in a professional discussion of viewpoints, ideas, and concerns, sharing information about their own teaching and about the program needs in the school.

Researchers have demonstrated that the most effective mathematics programs are those where collegial collaboration across classrooms is strongest. Interviewing is a first step in the collaborative process. The interview achieves two goals:

1) *It promotes open discussion about the teaching practices that colleagues in the mathematics department use; and*

2) *It records **individual** points of view, documenting the broad range of opinions, styles, and perspectives that exist.*

Procedures

Decide whether your team will conduct interviews individually or if the group will use only certain questions as the basis of a team discussion. Next, determine which specific questions or portions of the interview the team will use. Agree upon an interview procedure and schedule the interview discussions at convenient times and in a comfortable meeting place. The process will take several hours and should be broken into two or three sessions. Most importantly, conduct interviews in an atmosphere that encourages informality. Often refreshments help establish informality and encourage the open and candid exchange of ideas.

Suggestions for conducting effective interviews are summarized in Figure II-1 at the end of this section. All team members should read these reminders and become familiar with the interview format and questions. Some members may want to jot down notes and thoughts about items prior to the start of the actual interview session.

Appoint a group recorder to document individual comments and the discussion that follows. Record comments in an abbreviated form, without reference to individual speakers. Attempt to capture the members' core ideas and responses to each question.

Give each teacher an opportunity to answer every question. Although some colleagues may be uncertain, encourage everyone to offer a point of view, even if it is, "I am really not sure," or, "I don't think that applies in my situation." Some silence, allowing time for thought and active listening, encourages candor and serious reflection on the issues. These questions have NO RIGHT OR WRONG ANSWERS. Every answer contributes importantly to the group's understanding of the school's current mathematics program.

Remember, in completing this interview the team is not seeking consensus, criticizing, or making value judgments. Rather, colleagues have an opportunity to share openly with one another. Only if individuals are candid will the process establish the groundwork for reaching a broad consensus later -- one that reflects many varying and effective ways to teach mathematics.

Group interview meetings should be facilitated by one member of the mathematics team who is not also serving as a recorder. This person keeps the flow of the conversation going and, when necessary, reminds colleagues that judgements or arguments are not part of the data gathering process. The facilitator and the team should try to avoid getting "stuck" on one question, moving on through the interview as soon as each person's response has been offered and recorded.

When the interviews are complete, double-check to see that notes can be easily read and are summarized as simply as possible. Put the information aside until the remainder of the data are gathered using the other instruments.

Surveys

Overview

Two surveys provide important additional data about the mathematics program that cannot be readily observed or described in interviews. *The Mathematics Teacher Survey (MTS)* elicits details from individual mathematics teachers about their professional backgrounds, instructional approaches, and evaluation procedures. It also records information about supplemental programs available to students. *Resources for Student Learning (SR)* documents the materials available to students for learning mathematics and the extent of their use. On a straightforward checklist, teachers report how often students use various instructional tools, library and media resources, and mathematics manipulatives.

When the surveys are compiled, the team has a composite picture of resources needed to implement the problem-centered curriculum called for by the MAP Criteria for Excellence, the NCTM *Curriculum and Evaluation Standards for School Mathematics*, and others who are urging improvement in mathematics education. In many cases, teams can use these data as justification to central office leaders or community and parent groups for obtaining more modern instructional tools, additional staff development, or new special program options for students.

Procedure

The surveys are most useful when they are completed anonymously by each mathematics teacher in the department. After teachers complete the surveys, two or three department members, working together as a team, compile and summarize the data.

The data can be readily summarized on unused survey forms and set aside until the interviews and observations are complete. At that point, the survey data support the team's analysis of the interview and observations.

Statistical Profile

In assessing the status of an educational program, it is useful to have available comprehensive statistical documentation of students' mathematics achievement. The

Statistical Profile provides a place to record additional group information. The Profile is organized to examine achievement data by course level, grade, and by special population group. This allows teams to investigate how well its mathematics program addresses the needs of minority students and girls, groups traditionally poorly served by the nation's mathematics programs.

Some schools may need to consult the central office testing department to obtain test scores disaggregated by subpopulation groups. In other cases, reports of achievement test scores can be readily summarized for special groups within the school. As the team works on its assessment, it should compile whatever achievement information is available, record it on these or comparable forms, and include it in the overall analysis of the programs status and needs.

Preparing to Summarize Assessment Data

Once the data from interviews, observations, and surveys have been gathered, the team follows the steps below to compile all the information into an overview of the mathematics program.

Observations:

> All teachers who conducted observations tally their results, following the directions on the cover sheet of the Mathematics Classroom Observation (MCO). All completed MCOs are collected by a subcommittee and summarized to obtain a group frequency -- the total number of times each item on the MCO was observed -- which is then recorded on an unused MCO form. (For schools with Apple computers, a simple AppleWorks spreadsheet is available to tabulate the frequencies for each item across all observations.)

Interviews:

> A subcommittee of team members similarly reviews the results of the Mathematics Teacher Interviews and records the key ideas on an unused interview form.

Surveys:

> The same or another subcommittee (depending on the size of the assessment team) combines the results of the Mathematics Teachers Survey and the survey of Student Resources on unused copies of each form.

Statistical Profile:

> Designated team members gather whatever information from the Statistical Profile that the team decides it needs.

After the team has finished summarizing the data, but before it begins the action planning, ask the recorder and the facilitator to carefully organize the data so it can be re-used or referenced later. It is a good idea to place the instrument summaries, the cross-reference matrices, and the action plans in clearly marked envelopes or flexible notebooks. They should be well-labeled and placed in a secure location for later use by various team members in the next phases of the assessment.

This information, still in its raw summary form, should be accessible for team members to review prior to the meetings scheduled for data analysis. The team then schedules meetings to compile the data it has collected, using the guidelines that follow in Sections IV and V.

Figure II-1

INTERVIEWING TIPS

- Be familiar with the questions.
- Explain the purpose of the interview.
- Be natural and honestly friendly.
- Allow the interviewee time to reflect.
- Seek clarification when necessary.
- Stay on the topic.
- Maintain eye contact with the speaker.
- Avoid giving your personal opinions or reactions to questions.

Figure II-2

OBSERVATION TIPS

- Become familiar with the observation form and with the range of practices you will be recording.
- Understand each of the observation items to assure you accurately reflect the meaning and intent of the context observed.
- Place yourself in the classroom so you can observe both the students and the teacher easily and fully.
- Become accustomed to the room and its activity before recording observed items.
- Go beyond your biases, record only what you actually see or hear, and avoid making judgements on the basis of your initial reactions or your personal preferences of style or approach.
- Watch people closely, observing and noting their expressions and the meaning behind their actions.
- Listen for the meanings and ideas exchanged among the students and the teacher, and record them accurately.
- Look beyond surface behavior.
- Focus on what is observed, not what is missing.
- Arrange a time and place for a debriefing session.
- Express appreciation for some aspect of the observation that you found personally meaningful.

Section III

Assessment Instruments

Mathematics Classroom Observation (MCO)

Mathematics Teacher Interview (MTI)

Mathematics Teacher Survey (MTS)

Student Resources for Learning Mathematics (SR)

Statistical Profile (SP)

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CONDUCTING MATHEMATICS CLASSROOM OBSERVATIONS

1. Observations in mathematics classrooms focus on recording ***positive mathematics teaching practices.*** As a result, observers mark only "observed" items; items on the observation list that are not observed should be left unmarked. Maintain notes of special interest and your comments and reflections throughout the process, but record such notes *without reference to any individual teacher.*

2. Each participating faculty member who teaches mathematics should be visited by a colleague either weekly or bi-weekly over the designated observation period. In general, teachers should not be observed more than once each week.

3. Observations should last about 15 to 20 minutes, or as long as is necessary to record the representative activities and context associated with the observed portion of the day's lesson. If possible, visits should be staggered to obtain representative samples of the beginning, middle, and end of each teacher's classes. Teachers' preferences for visitation times should be solicited and honored.

4. Try to avoid conducting observations in September, May, or June, since these are unusual periods in the school calendar and observation data will not yield a representative picture of the program.

5. Each observer uses ***a single observation form*** for recording up to 10 observations and making comments. Blending multiple observations on one form assures teachers' anonymity and provides a more easily recorded picture of the varying approaches to mathematics teaching used by all faculty members in your department.

6. After you have recorded 10 observations, tally across the number of times each observation item was marked. Summarize your comments and relevant notes, integrating the notes you take during your feedback discussions (see Item #8 below). Indicate with an asterisk (*) the **10** items observed most frequently. Place a check mark (✓) next to any items not observed at all or observed infrequently. Present this information to your team or discussion group for analysis with the results from other observers.

7. Be certain that all participating teachers receive a copy of these instructions, along with the Mathematics Classroom Observation Form, so that everyone is fully informed of the observation process.

8. Both observers and the teachers they observe should take the time to exchange reactions about the observation experience. To do this, observers leave a Post-Observation Feedback Sheet (attached to the observation form) with the colleagues they observe, suggesting a meeting time and place for discussion. It is not necessary to conduct formal or lengthy sessions after each observation period, but please do take time periodically for an extended discussion about what you each have learned from the experience of several observations. The procedures for conducting this feedback interview are described in the guidelines provided on the feedback form itself.

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MATHEMATICS CLASSROOM OBSERVATIONS

Record 10 observations on a single form, indicating the date of each observation. In the appropriate column mark only those items that are actually observed. Leave the item blank if it is not observed. Informal comments and extended discussion of your observations may be helpful in later analysis and should be recorded on the last page of this observation form or on added pages. After completing the tenth observation, detach this page in order to maintain the anonymity of those observed.

Observations should last approximately 15 minutes, or as long as necessary to fully record the representative activities and context associated with the portion of each class observed.

OBSERVATION SCHEDULE

ROOM	DATE	TIME	ROOM	DATE	TIME
1. ________	____	____	6. ________	____	____
2. ________	____	____	7. ________	____	____
3. ________	____	____	8. ________	____	____
4. ________	____	____	9. ________	____	____
5. ________	____	____	10. ________	____	____

NOTES:

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Observer's Name: ______________________

MATHEMATICS CLASSROOM OBSERVATION

Observer ______________________

Instructions

To ease the recording of your observations, the checklist on the following pages has been divided into three sections. The first section includes ***physical characteristics of the classroom.*** *They should be noted while you are in the classroom. The second group of items includes* ***instructional processes*** *that should be marked as they are observed. The third group includes* ***general items*** *that need not be marked until after leaving the room. Mark each item only once, regardless of how many times you observe it.*

SECTION I: Physical Characteristics of the Classroom

The following items describe characteristics of the classroom environment. They should be noted while you are in the classroom.

IDEALS	PHYSICAL CHARACTERISTICS OF THE CLASSROOM *Mark If Observed*	Observation Number: / Date:	1	2	3	4	5	6	7	8	9	10	TOTAL
[D-5]	1. The seating arrangement in the classroom can best be described as:												
	a. Seating arranged in rows		❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
	b. Seating arranged in semi-circles		❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
	c. Seating arranged in clusters		❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[D-5]	2. Adequate numbers of textbooks and instructional materials are available for students to do their classwork.		❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[E-4]	3. Student work is displayed on bulletin boards.		❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[F-2]	4. On display are imaginative applications of mathematics such as patterns, numerical and spatial relationships, algebraic models, graphics, etc.		❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[F-3]	5. The natural or artistic uses of mathematics (e.g., symmetry, balance, pattern in nature, graphic representations, shape and space manipulations, and constructions) are displayed in the classroom.		❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[F-5]	6. Student displays and/or projects demonstrate the modern use of mathematics in many nations, including third-world countries.		❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[I-8]	7. Instructional materials represent various racial and ethnic groups doing mathematics and/or related work.		❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____

SECTION II: Instructional Processes

The following items describe interactions between students and teachers and among students. They should be marked as they occur, while you are observing the lesson. Regardless of how often they occur, mark them only one time per observation period.

IDEALS	INSTRUCTIONAL PROCESSES *Mark If Observed* — Observation Number: / Date:	1	2	3	4	5	6	7	8	9	10	TOTAL
[B-1]	**8.** Most students' facial expressions and/or body postures reflect their active involvement, attentiveness, and/or interest in mathematics.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[B-1]	**9.** Students are actively engaged in doing mathematics. Mark all that apply:											
	a. Building and discussing models	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	b. Measuring or estimating	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	c. Working with manipulatives	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	d. Gathering and interpreting data	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	e. Making or reading graphs	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	f. Playing mathematical games	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	g. Debating	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	h. Explaining or demonstrating	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	i. Drawing diagrams	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	j. Writing about results	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	k. Using calculators	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	l. Using computers	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[C-7]	**10.** The teacher illustrates discussions and explanations using (mark those that apply):											
	a. Chalkboard or chartpaper	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	b. Overhead projector	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	c. Physical models or manipulative materials	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	d. Computer monitor	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	e. Text	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[C-2]	**11.** In their instruction, teachers use real-life mathematical applications or models, as well as numbers and algorithms.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[B-6]	**12.** Which of the following components of the teacher's lesson were observed? Please mark all that apply:											
	a. Review of previously introduced ideas	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	b. Concept development	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	c. Skill development	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	d. Routine application problems	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	e. Non-routine problem solving	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	f. Homework assignment, explanation, or review	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[B-7]	**13.** Mathematics assignments include projects and/or problems that extend beyond the immediate classroom.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	14. Teacher's talk includes questions like the following (mark those that apply):											
[C-1]	**a.** Are there other valid solutions to this problem? What might be a different approach or strategy?	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____

IDEALS	INSTRUCTIONAL PROCESSES *Mark If Observed* — Observation Number: / Date:	1	2	3	4	5	6	7	8	9	10	TOTAL
[C-4]	**b.** Have we made an error here? Can you find my mistake?	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[C-5]	**c.** What do you think? Why do you think that? How did you arrive at your answer? How can you prove to us that you are correct?	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[C-2]	**15.** Teachers use estimation and/or hypothesis testing as tools.	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[C-4]	**16.** Teachers help students take accurate notes, pose questions, organize materials, and in other ways improve their analytical skills.	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[C-5]	**17.** In their discussions, students and teachers use correct mathematical language in appropriate ways.	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[C-6]	**18.** Students give oral or written evidence of mathematical experiments, discoveries, processes, and/or strategies.	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	
[C-7]	**19.** Teachers give clear, concise explanations, adjusted to meet the needs of students who are confused or have questions.	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[C-7]	**20.** Teachers listen thoughtfully to students and provide sufficient time for students to ask and to respond to questions.	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[D-1]	**21.** Girls and minority students are full and equal participants in class.	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[D-2]	**22.** Student groups reflect:											
	a. Racial/ethnic diversity	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
	b. Gender diversity	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[D-3]	**23.** Teachers accommodate students' special needs, abilities, and disabilities.	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[D-5]	**24.** The classroom environment encourages participation by ***all*** students.	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[E-4]	**25.** Teachers praise and reward all students, regardless of achievement levels, for their use of unique and inventive problem-solving methods.	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[E-6]	**26.** Teachers respond constructively to their students' incorrect answers and encourage them to risk making mistakes.	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[F-1]	**27.** Teachers' comments link the assigned topics to students' interests.	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[F-1]	**28.** Teachers relate students' mathematical experiences to assignments in other classes and/or to students' lives outside of school.	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[F-2]	**29.** Computational work is pr[illegible]iced in imaginative contexts, through games or by solving problems that relate to students' everyday lives.	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____

IDEALS	INSTRUCTIONAL PROCESSES *Mark If Observed*	Observation Number: Date:	1	2	3	4	5	6	7	8	9	10	TOTAL
[F-5]	**30.** Teachers refer positively to careers that use mathematics and/or they encourage *all* students, regardless of gender or ethnic group, to consider entering these fields.		❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[G-1]	**31.** Teachers are visibly enthusiastic and positive about the material they are teaching.		❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____

Section III: General Items

The items in this section should be reviewed immediately after the classroom observation and marked if they were observed.

IDEALS	GENERAL INFORMATION *Mark If Observed*	Observation Number: Date:	1	2	3	4	5	6	7	8	9	10	TOTAL
[A-8]	**32.** Students demonstrate an understanding of the practical applications of mathematical terms, concepts, and/or algorithms.		❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[B-2]	**33.** Students use manipulatives to make the problems they are working on more concrete.		❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[B-3]	**34.** Students work individually on activities and/or assignments.		❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[B-3]	**35.** Students work cooperatively in small and/or large groups.		❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[B-5]	**36.** Students use computers for generating both mathematical problems and solutions (i.e., not just for drill and practice).		❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[B-5]	**37.** Students use calculators for analyzing problems and finding solutions (i.e., not just for routine calculation).		❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[C-3]	**38.** Students develop their own ideas, strategies, and/or mathematical rules or procedures.		❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[C-3]	**39.** Students invent problems, discover solutions, or engage in mathematical games.		❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[C-6]	**40.** Students discuss each others' logic and/or problem-solving methods and mathematical strategies.		❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[E-3]	**41.** Students help develop classroom expectations, rules, and procedures.		❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[G-1]	**42.** Teachers demonstrate understanding of the mathematical concepts they are teaching.		❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____
[H-5]	**43.** Parents and/or community representatives are visible partners, working with students in mathematics activities and programs.		❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	____

Please add any comments or extensions of your observations that enhance your understanding of the activity and processes observed. Indicate the date and observation number, but do not record the name of the teacher observed.

MATHEMATICS CLASSROOM OBSERVATION POST-OBSERVATION FEEDBACK SHEET

Observation of teaching among colleagues is an essential method of exchanging ideas and broadening teaching perspectives. It also is a rewarding way for colleagues to share ideas and to provide mutual support. To promote such an exchange, observers and observed colleagues are encouraged to discuss the observation process with one another at a convenient time soon after each observation takes place. To facilitate this exchange, observers should schedule a meeting to discuss the portion of the lesson observed, using these questions to guide your discussions.

1. How do you think the observed portion of the lesson went? Were you pleased or disappointed? Briefly explain.

2. What were you hoping would happen during that period? If it happened that way, where will you go from here? If not, what altered the plan and what will you do next?

3. Would you describe this lesson as typical? If so, in what ways is it typical of other days' lessons? If not, in what ways was it different?

4. Is there anything in particular that I should have paid attention to while I was there?

Scheduled debriefing time/place ______________________________

Observer ____________________________ Class/Time/Date Observed __________________________________

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MATHEMATICS TEACHER INTERVIEW

Thank you for your willingness to contribute to the assessment of our school's mathematics program. Your responses to the questions below will provide us with information about how well our school meets criteria for successful middle-grades mathematics programs. Your responses and candid views will help us plan our program improvements. As we talk, I will be taking notes on what you are saying, but, please be assured, your responses will remain absolutely confidential and anonymous.

(NOTE TO INTERVIEWER: **This is a two- or three-part interview. You may stop at any convenient point and continue at another scheduled time. The letters and numbers under the heading "Ideals" refer to the nine Criteria for Excellence and the accompanying Ideals.)**

IDEALS QUESTIONS NOTES

[A-4] **1.** Let's begin by discussing some topics and skills that sometimes are included in middle-grades mathematics. I'd like to start in the area of "number and operation sense." Please tell me which of these topics will or will not be taught in your class this year. For those that will not be taught, please explain why.

	Will Be Taught	Will Not Be Taught	Uncertain
Equivalent forms for numbers (integers, fractions, decimals, etc.)	______	______	______
Ratios, proportions, percents	______	______	______
Graphing on the number line and in the plane	______	______	______
Order relations for whole numbers, fractions, decimals, and integers	______	______	______
Operations on whole numbers, fractions, decimals, and integers	______	______	______
Number theory (primes, factors, multiples, etc.)	______	______	______
Alternative algorithms for computation	______	______	______
Estimation techniques and applications	______	______	______
Mental computation	______	______	______

[A-5] **2.** Now, I will read a list of topics relating to "spatial and measurement sense." Please tell me which of these topics will be taught and which will not be taught in your classes this year. For those that will not be taught, please explain why.

	Will Be Taught	Will Not Be Taught	Uncertain
Describing and comparing geometric figures	______	______	______
Visualizing and drawing geometric figures	______	______	______
Transformations: reflections, rotations, translations	______	______	______
Geometric properties and relationships	______	______	______
Estimating, making, and using measurements	______	______	______
Selecting appropriate units and tools	______	______	______
Perimeter, area, and volume	______	______	______
Angle measure	______	______	______
Formulas and procedures for solving problems	______	______	______
Scale and scale conversions	______	______	______
Tessellations	______	______	______

IDEALS	QUESTIONS	NOTES

[A-6] **3.** Here is a list of topics related to probability and statist :s. Please respond as before.

	Will Be Taught	Will Not Be Taught	Uncertain
Determining probabilities experimentally	______	______	______
Expectations and predictions	______	______	______
Collecting, organizing, and describing data	______	______	______
Reading and interpreting tables, charts, and graphs	______	______	______
Making inferences based on data analysis	______	______	______

[A-7] **4.** Finally, here is a list of topics related to algebra. Please respond as before.

	Will Be Taught	Will Not Be Taught	Uncertain
Concepts of variable, expression, and equation	______	______	______
Representing number patterns with tables, graphs, and equations	______	______	______
Analyzing tables and graphs	______	______	______
Solving linear equations using concrete, informal, and formal methods	______	______	______
Inequalities and non-linear equations	______	______	______

[A-8] **5.** There is a continuing debate in mathematics education over which comes first—concept building or skills development. What do you emphasize in your classroom?

[A-1] **6.** How do you assure that your curriculum provides a *problem-centered context* for learning mathematics?

[B-2] **7.** In what ways do your students use mathematics tools, physical models, and manipulative materials to develop their grasp of mathematical meaning?

[A-2] **8.** What kinds of problem-solving activities do you do in class, besides what is in the textbook?

IDEALS	QUESTIONS	NOTES
[C-1]	**9.** How do you assure that students learn to use a *variety of strategies* for solving problems (e.g., using manipulatives, experimenting with different solution procedures, mental as well as written calculation, individual as well as collaborative problem-solving)?	
[C-2]	**10.** What would you do if you found you could not work a problem that you had assigned your students?	
[C-4]	**11.** How do you integrate the teaching of reasoning and analysis into your mathematics instruction?	
[D-4]	**12.** What techniques do you use to encourage thinking and problem-solving among students who have difficulty learning mathematics?	
[D-3]	**13.** What techniques do you use to challenge students who are especially good in math?	
	What accommodations do you make for special education students in your math program?	
	What accommodations do you make for developing English speaking students in your math program?	
[F-1]	**14.** What are some of the ways you relate mathematics to students' individual interests?	

IDEALS	QUESTIONS	NOTES	
[F-3]	**15.** Does your curriculum include artisitic and scientific applications of mathematical ideas in other subject areas? Please give some examples.	❑ Yes	❑ No
[C-6]	**16.** In what ways do you encourage students to speak and to write about mathematics? For instance, do students describe their mathematical procedures to one another or write about their mathematics learning in journals? Please give other examples from your classes.	❑ Yes	❑ No
[C-3]	**17.** How do you help students develop their ability to pose problems and to discover solutions for themselves?		
[E-5]	**18.** How do you help students understand that inventive and thoughtful use of mathematical strategies is as important as accuracy in skill development? For example, do you ever give partial credit for correct methods that do not yield correct answers? If not, why not?	❑ Yes	❑ No
[E-6]	**19.** How do you encourage risk taking in mathematics learning and show your students that they can learn from their mistakes?		
[I-8]	**20.** What mechanisms are in place in this school for screening mathematics textbooks, tests, and other classroom materials to avoid gender, racial, or ethnic bias?		
[H-5]	**21.** Are there some ways parents help in your classroom or in other school-wide mathematics activities in school or outside? Please give examples.	❑ Yes	❑ No

IDEALS	QUESTIONS	NOTES	
[F-5]	**22.** Do you use resource speakers, outside consultants or experts from neighboring businesses to demonstrate the connections between mathematics and the world we live in?	❑ Yes	❑ No
	What efforts do you make to expose all students—especially girls and minority students—to role models in mathematics-related fields?		
[B-5]	**23.** Are you currently using computers or calculators in your mathematics program? How are they used for in-class assignments or homework?	❑ Yes	❑ No
	What about on tests?		
[B-5]	**24.** How do you integrate calculators and computers as learning tools for *all* students—those with developing mathematics understanding as well as advanced groups?		
	What kinds of staff development have you had to learn to use computers with middle-grades mathematics students?		
[I-7]	**25.** Do you know if Your school's mathematics program is coordinated with the local elementary and high school programs? If so, how?	❑ Yes	❑ No
	What more can be done to improve the coordination of the program across all grades, K-12?		

IDEALS	QUESTIONS	NOTES
[B-1]	26. In your classroom, how do you engage your students both intellectually ***and physically*** in the process of learning mathematics?	
[E-3]	27. How do you help students plan their own classroom work time and evaluate their achievements in meeting challenging classwork, homework, and project responsibilities?	
[B-3]	28. How do you organize your program so that students have the opportunity to work in groups as well as independently?	
[B-7]	29. What opportunities do your students have for participating in mathematics-related activities outside the regular classroom?	
[D-1]	30. Do the participants in these math activities equitably represent all racial, ethnic, and gender groups in the student population? If not, what is done to try to involve these groups that often are underrepresented in mathematics programs?	❑ Yes ❑ No
	In general, how do you ensure that girls and minority students are especially encouraged to excel in mathematics?	
[E-1]	31. Some people believe that mathematics is a subject that not everyone can master; others disagree. What do you think about this issue?	

IDEALS	QUESTIONS	NOTES

[D-2] **32.** In addition to standardized achievment tests, what criteria are used to determine student placements in math courses?

How does the department staff assure that such placements are flexible and change as students improve?

[C-5] **33.** What percentage of class time would you say you typically devote to having students ***talk with you*** about their mathematics procedures or ideas (as opposed to simply supplying steps or answers)?

[E-4] **34.** How do you recognize and encourage students' achievements in mathematics?

How do you reward the achievements of students who are least proficient in mathematics?

[I-1] **35.** Please describe what you use ***in addition*** to teacher-made or standardized test scores to evaluate your students' math progress?

Do you ever use students' writing about mathematics, their project work or their own self-evaluations as part of their mathematics grade? Please explain. ❑ Yes ❑ No

IDEALS	QUESTIONS	NOTES
[I-4]	**36.** How does the school assure consistency in its grading policy across all mathematics classes? How do you and your colleagues assure that the grading policy is consistent and fair to all students within your classes?	
[B-8]	**37.** Describe your homework policy, i.e., the kinds of homework problems you assign and how much and how often you assign different types of homework.	
[A-3]	**38.** What strategies do you use to assure the mathematics curriculum balances concept building, problem solving, and procedural skill development (e.g., basic operations and rote skills, etc.) so students become more successful mathematics achievers?	
[E-7]	**39.** In what ways do you help *all* parents and families understand that every child can excel in mathematics?	
[I-2]	**40.** How do you communicate to parents and to students about students' progress and achievements in classwork, homework, and on both in-class and standardized assessments?	
[I-5]	**41.** How do you and your colleagues know if your school's overall mathematics program is working for your students? In what ways do you verify that the program addresses the special needs of minority students and girls in particular?	

IDEALS	QUESTIONS	NOTES
[G-4]	**42.** How often do you work with colleagues in mathematics ***and in other subject areas*** to plan, teach, or extend your skills as a mathematics teacher?	
[G-6]	**43.** What opportunities are there for members of the mathematics department to plan together, observe one another, and exchange feedback ***during the school day***?	
[F-4]	**44.** What do you and your colleagues do to integrate the use of mathematics into other subject areas?	
[G-3]	**45.** How are the mathematics teachers in this school involved in setting and reviewing the school's mathematics program goals and objectives?	
[I-6]	**46.** How are suggestions about improving the mathematics program obtained from teachers in other subject areas?	
[G-1]	**47.** Please describe any specialized training and experiences you have to prepare you to teach mathematics in the middle grades.	
[D-6]	**48.** Describe the in-service or staff development programs that have been available in your school or district to develop teachers' expertise with middle-grades mathematics students.	

IDEALS	QUESTIONS	NOTES
[G-3]	**49.** What role does the mathematics faculty have in planning and implementing its own in-service and staff development?	
[G-5]	**50.** How does this school's administration as well as the district's leadership support or encourage your participation in local, state, or national mathematics associations, meetings, or specialized academic institutes and conferences?	
[G-2]	**51.** How do both the school and district administrators support or encourage other forms of professional development (e.g., college courses, workshops, seminars, etc.)?	
[G-1]	**52.** On what basis is the mathematics department head selected?	
	Are there special qualifications, experiences, or skills the math department head should have?	❑ Yes ❑ No
[H-2]	**53.** What kinds of information do you provide to parents about the rationale behind the content and the teaching procedures you use in your mathematics classes?	
[H-3]	**54.** What do you do if you find your students need additional academic support in mathematics, either for remediation or enrichment?	
	Who in your school is responsible for alerting parents to the availability of special enrichment programs or tutoring assistance for students?	

IDEALS	QUESTIONS	NOTES
[H-4]	**55.** Who in your school explains to parents about math curriculum options and their later consequences for students?	
[H-1]	**56.** What are some ways that parents and community members contribute to evaluating or improving the school's mathematics program?	
[A-9]	**57.** How do you and your staff assure that the mathematics program responds to the findings of research in mathematics teaching and learning and to the demands of a rapidly changing technological society?	
[B-4]	**58.** How do your students' mathematics assignments require them to demonstrate in their own words the meaning of mathematical ideas of number, relationships, patterns, and operations? Can you give specific examples?	
[B-6]	**59.** What, in your view, is a good balance between new material and review and classwork and homework in the middle-school math program?	
	What do you do to try to achieve that balance?	
[C-7]	**60.** Students' understanding of mathematics concepts develops, in part, when they talk out loud about their mathematical thinking. When students talk mathematically in this way, what are you listening for?	
	What are some strategies you use to help students when you realize they do not understand the underlying concepts of the mathematics they are using?	

IDEALS	QUESTIONS	NOTES
[D-5]	**61.** What are some specific ways that you encourage students to contribute their mathematics ideas, classwork and homework, and imaginative thinking to make the classroom environment an inviting and mathematically stimulating place to be?	
[E-2]	**62.** Many students do not believe they can be successful in mathematics. How do you encourage the confidence and risk taking required for students to discover their potential for success as mathematics learners?	
[E-8]	**63.** What do the support personnel (counselors, psychologists, librarians, administrators) in your school do to encourage students to continue studying mathematics seriously in the middle grades and throughout their high school years?	
[E-9]	**64.** How do members of the community's private and public sectors, e.g., employes in business, industry, and government agencies, demonstrate to students how important it is for them to learn mathematics?	
[F-2]	**65.** Mathematics is an imaginative and inventive field of study. What are some examples of things you do with students to help them use mathematics imaginatively and creatively both inside and outside of the classroom?	
[H-2]	**66.** What do you do to determine how well your mathematics program achieves the school, district, and statewide goals for student achievement?	

Thank you for sharing your time and your thinking.

If there are other comments or suggestions you would like to contribute to this assessment of our mathematics program, please do so at this time.

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MATHEMATICS TEACHER SURVEY

This survey helps provide teachers with background information to guide the assessment of their mathematics program and to determine needs for further staff and program development.

I. Professional Background [Ideal G-2]

1. List the certification, endorsement, or special training you have in teaching mathematics in the middle grades

2. List postgraduate courses, workshops, or other training in mathematics or mathematics teaching in the last five years for which your school or school district has either reimbursed you for tuition or has offered during paid release time.

3. What local, state, or national professional associations do you hold membership in?

4. Which of the following journals do you read regularly?
Arithmetic Teacher
Mathematics Teacher
The Elementary Mathematician
NCTM News Bulletin
Teacher
Education Week
Other:

II. Instructional Approaches [Various Ideals in Criterial A-C]

How often do you use each of the following techniques in teaching mathematics to your classes?

			Daily	Weekly	Monthly	Rarely	Never
[B-2]	1.	Students using manipulatives	❑	❑	❑	❑	❑
[B-3]	2.	Students working in groups or teams	❑	❑	❑	❑	❑
[B-3]	3.	Group projects	❑	❑	❑	❑	❑
[B-4]	4.	Demonstrating/modeling	❑	❑	❑	❑	❑
[B-4]	5.	Library work/research	❑	❑	❑	❑	❑
[B-4]	6.	Workbooks	❑	❑	❑	❑	❑
[B-5]	7.	Calculator problem solving	❑	❑	❑	❑	❑
[B-5]	8.	Computer drill and practice	❑	❑	❑	❑	❑
[B-5]	9.	Computer problem solving	❑	❑	❑	❑	❑
[B-5]	10.	Televised instruction	❑	❑	❑	❑	❑
[A-8]	11.	Review of concepts and procedures (skills)	❑	❑	❑	❑	❑
[B-3]	12.	Individual projects	❑	❑	❑	❑	❑
[B-7]	13.	Math-related field trips	❑	❑	❑	❑	❑
[C-3]	14.	Students generating and/or solving real-life problems	❑	❑	❑	❑	❑
[C-5]	15.	Questioning students	❑	❑	❑	❑	❑
[C-5]	16.	Whole-class discussion	❑	❑	❑	❑	❑
[C-6]	17.	Journals and mathematical writing	❑	❑	❑	❑	❑
[C-6]	18.	Student-led discussion	❑	❑	❑	❑	❑
[C-7]	19.	Lecture/exposition	❑	❑	❑	❑	❑
[D-3]	20.	Individualized assignments	❑	❑	❑	❑	❑
[H-5]	21.	Guest speakers	❑	❑	❑	❑	❑
[I-1]	22.	Teacher-made tests and/or quizzes	❑	❑	❑	❑	❑
[I-1]	23.	Text-based assignments or tests	❑	❑	❑	❑	❑
[A-1]	24.	Concepts are taught using routine and non-routine problems	❑	❑	❑	❑	❑
[B-8]	25.	Homework extends learning and applies skills	❑	❑	❑	❑	❑

COMMENTS:

III. Evaluation Procedures [Ideals I-1 and I-5]

Check any of the following diagnostic procedures you use to evaluate students' mathematics skills and their development throughout the year. Note: This list surveys the range and frequency of many evaluation options; not all of these procedures are appropriate in every context.

		Beginning of Year	Routinely	Each Unit or Quarterly	End of Year	Not Used
1.	Informal diagnostic observation	☐	☐	☐	☐	☐
2.	Listening to students think aloud as they solve problems.	☐	☐	☐	☐	☐
3.	Journals of mathematical reflections	☐	☐	☐	☐	☐
4.	Students' written descriptions of mathematical problem-solving processes	☐	☐	☐	☐	☐
5.	Homework	☐	☐	☐	☐	☐
6.	Quizzes	☐	☐	☐	☐	☐
7.	Individual projects and presentations	☐	☐	☐	☐	☐
8.	Group projects and presentations	☐	☐	☐	☐	☐
9.	Student-generated computer programs	☐	☐	☐	☐	☐
10.	Student-generated mathematics problems	☐	☐	☐	☐	☐
11.	Conferences with:					
	Students	☐	☐	☐	☐	☐
	Parents	☐	☐	☐	☐	☐
	Other teachers	☐	☐	☐	☐	☐
12.	Tests					
	Teacher-made tests	☐	☐	☐	☐	☐
	Department-created tests	☐	☐	☐	☐	☐
	District-created tests (not standardized)	☐	☐	☐	☐	☐
	Textbook tests and inventories	☐	☐	☐	☐	☐
	Standardized normed achievement tests	☐	☐	☐	☐	☐
	Standardized criterion-referenced tests	☐	☐	☐	☐	☐
	Standardized individual or group diagnostic tests	☐	☐	☐	☐	☐

13. Please also describe any other assessment techniques you use, indicating when and how you use them.

14. Of all the tests you administer, indicate those for which results are routinely sent to students and parents and which are discussed in individual conferences.

15. List below those evaluation procedures that are used specifically to address:
    a. school goals

    b. district goals

    c. state or national goals.

ADDITIONAL COMMENTS:

64

IV. Special Programs in Mathematics [Various Ideals in Criteria D, E, and H]

In the space below, list in-school or after-school mathematics programs or activities in which the students in your class participate. Include remedial assistance, mathematics clubs, academic competitions, and programs in which parents or community volunteers assist or sponsor mathematics activities.

1. Program name: ______________________ # of participants __________
   Brief description and target group:

2. Program name: ______________________ # of participants __________
   Brief description and target group:

3. Program name: ______________________ # of participants __________
   Brief description and target group:

4. Program name: ______________________ # of participants __________
   Brief description and target group:

Do the participants in these programs equitably represent all racial, ethnic, and gender groups underrepresented in the student population. Which group(s), if any is/are underrepresented?

What is done to avoid underrepresentation of minorities, females, or developing English speakers in these programs?

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STUDENT RESOURCES FOR LEARNING MATHEMATICS

Please use this survey to record whether or not items are present in your classroom or school, regardless of where they are located. Provide a rough estimate of how frequently you use each item with your students.

	Used Regularly	Available but Rarely Used	Not Available

I. Student Resources for Mathematics

	Used Regularly	Available but Rarely Used	Not Available
A work area or laboratory is designated for students to receive additional help on math skills.	______	______	______
The following resources are available for students to use in mathematics:			
1. Art supplies	______	______	______
2. Arithmetic calculators	______	______	______
3. Scientific calculators	______	______	______
4. Graphics calculators	______	______	______
5. Computers for student use	______	______	______
6. Drill and practice software	______	______	______
7. Mathematical games	______	______	______
8. Geometric models	______	______	______
9. Manipulative materials	______	______	______
10. Supplementary workbooks and resources	______	______	______
11. Thinking and problem-solving software	______	______	______

II. Media Center/Library

	Used Regularly	Available but Rarely Used	Not Available
A. Mathematics references in the library or classrooms:			
1. Books about careers using mathematics	______	______	______
2. Mathematics-related magazines	______	______	______
3. Newsletters that include mathematical problem-solving challenges/solutions	______	______	______
4. Information emphasizing minority involvement in mathematical sciences	______	______	______
5. Information about mathematical work in other nations, including third-world countries	______	______	______

66

	Used Regularly	Available but Rarely Used	Not Available
B. Displays			
1. Mathematical models and designs	______	______	______
2. Students' mathematics projects	______	______	______
3. Displays emphasizing minority involvement in mathematical sciences	______	______	______
C. Space and physical arrangements:			
1. Large group instruction area	______	______	______
2. Small group research/meeting areas	______	______	______
3. Flexible seating arrangements	______	______	______
4. Mathematics-focused reference area for students	______	______	______

III. Mathematics Manipulatives

Students use the following manipulative materials:

	Used Regularly	Available but Rarely Used	Not Available
1. Algebra-related manipulatives	______	______	______
2. Attribute blocks	______	______	______
3. Base-ten blocks	______	______	______
4. Chart paper	______	______	______
5. Chip trading sets	______	______	______
6. Compasses	______	______	______
7. Cubes	______	______	______
8. Cuisenaire apparatus	______	______	______
9. Dice	______	______	______
10. Dot paper	______	______	______
11. Fraction bars	______	______	______
12. Geoboards	______	______	______
13. Geometry construction materials	______	______	______
14. Metric measuring devices	______	______	______
15. Pattern blocks	______	______	______
16. Protractors	______	______	______
17. Rulers	______	______	______
18. Scales	______	______	______
19. Scientific measuring instruments	______	______	______
20. Scissors	______	______	______
21. Spinners	______	______	______
22. Tessellation drawing paper	______	______	______
23. 3-dimensional models	______	______	______
24. Tiles	______	______	______

	Used Regularly	Available but Rarely Used	Not Available
25. Other (list)			
________	________	________	________
________	________	________	________
________	________	________	________
________	________	________	________
________	________	________	________

Other materials and/or comments:

68

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STATISTICAL PROFILE

NOTE: The forms in this section are useful for generating a statistical profile that can help clarify how various segments of the student population currently are being served by your school's mathematics program. Use these forms or revise them to suit your school's needs.

I. MATHEMATICS COURSE ENROLLMENT *(by course level, grade, and special population)*

TEACHER: ____________

Complete a separate enrollment profile for each grade. For each, indicate the number and percentage of students, by gender, within each of the groups listed below.

MATHEMATICS COURSE LEVEL AND GRADE	AFRICAN AMERICAN		ASIAN		LATINO		NATIVE AMERICAN		OTHER MINTORITY		CAUCASIAN		DEVELOPING ENGLISH-SPEAKING STUDENTS (LEP, ESL,etc.)	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Regular Mathematics Grade ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____
Advanced or Honors Mathematics Grade ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____
Algebra Grade ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____
Remedial Mathematics Grade ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____
Special Education Mathematics Grade ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____

II. GRADE-LEVEL MATHEMATICS ACHIEVEMENT TEST DATA *(by sub-test and grade)* TEACHER: ____________

NOTE: **If more than one standardized test is administered, report the data for the most commonly used test. If local test data are not available in this format, modify this form as necessary.**

Name of standardized mathematics test used: ______________________________

Form: ____________________ **Year Published:** __________ **Date Administered:** ____________

Check the appropriate box to indicate the type of test score reported:

A.
- ☐ Percentiles
- ☐ Normal Curve Equivalent (NCE)
- ☐ Standard Score

B.
- ☐ Mean
- ☐ Median

Percentile or Average Scores *(by subtest and grade)*

List Each Mathematics Subtest (e.g., Skills, Problem Solving, Concepts)	Grade: ______	Grade: ______	Grade: ______	Grade: ______

72 73

Percentage of Students Scoring at or Above 40th Percentile *(by subtest and grade)*

List Each Mathematics Subtest	Grade: ____	Grade: ____	Grade: ____	Grade: ____

Percentage of Students Scoring at or Below 25th Percentile *(by subtest and grade)*

List Each Mathematics Subtest	Grade: ____	Grade: ____	Grade: ____	Grade: ____

III. SCHOOLWIDE ACHIEVEMENT DATA *(by grade and racial/ethnic group)*

TEACHER: ____________

NOTE: These data can be helpful in identifying achievement disparities among racial and ethnic groups in your school. Such gaps can be addressed by appropriate program adjustments. To complete this form, the department may need to consult with school-level adminstrators or the testing personnel in the district office for assistance. Modify headings to suit the needs of your student population and school.

Name of standardized mathematics test used: ____________

Form: ____________ Year Published: ____________ Date Administered: ____________

Check the appropriate box to indicate the type of test score reported:

A.
- ❑ Percentiles
- ❑ Normal Curve Equivalent (NCE)
- ❑ Standard Score

B.
- ❑ Mean
- ❑ Median

GRADE LEVEL	ALL STUDENTS		AFRICAN AMERICAN		ASIAN		LATINO		NATIVE AMERICAN		OTHER MINORITY		CAUCASIAN	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____
	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____
	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____
	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____
	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____	# ____ % ____

Section IV

Summarizing and Analyzing MAP Data

Section IV

Summarizing and Analyzing MAP Data

The team now uses the knowledge it has gained from discussions, observations, and other data gathering to determine how consistent the school's mathematics program is with the MAP Criteria for Excellence. This is the first step toward action planning. Three tools are available in this section to prepare the data for action planning:

- Criteria and Ideals Cross-Reference (Worksheet 1)
- Consistency/Priority Rating Summary (Worksheet 2)
- Decision Matrix (Worksheet 3)

It is preferable to work as a team to analyze the data, but a large group could be subdivided. If the team is divided, each subgroup should include teachers who represent the various points of view and teaching styles that are typical of the department.

The analysis of the data calls for discussion and decision-making. The results will be used to demonstrate the mathematics program strengths, and to design an action plan for improvement and change. Thus, it is important to include every member of the mathematics team who will be affected by the resulting plan.

Begin by scheduling several meetings for completing the analysis. Meet in a comfortable place, encourage members to contribute refreshments, and assemble planning materials such as paper, pencil, possibly a computer, chart paper and/or chalk broad, etc. It may also be helpful to meet where there are duplicating facilities and other office supplies.

One team member records all decisions the group makes. A second member serves as a discussion leader. The team uses the available data from the instrument summaries, along with reflections on their observations to determine the goals for action planning. Three decision-making steps lead to the planning phase:

1. Decide the degree of program consistency with each of the MAP Ideals;
2. Reach agreement on the level of priority for each Ideal; and
3. Graph program strengths and Ideals for action planning.

Follow the steps below to complete the analysis.

Step 1. Decide the degree of program consistency with each MAP Ideal.

a. The recorder begins by reading out loud Criterion A, Ideal 1 on the Cross-Reference (Worksheet 1) and the instrument item numbers listed beside that Ideal.

b. The team members locate the appropriate question(s) in their instrument summaries and read the findings. The team discusses and debates how consistent or inconsistent the current mathematics program is with each stated Ideal.

Using personal observation combined with information available from the instruments, the team assigns each Ideal a consistency rating of one to five, using the following scale:

5 = Completely consistent with the Ideal

3 = Moderately consistent with the Ideal

1 = Inconsistent with the Ideal

Record the consensus rating in the left margin, next to the Ideal statement on Worksheet 1, the Cross-Reference. Also record any relevant notes from the findings that may help when you reach the action planning stage.

c. Continue to determine the consistency or inconsistency of every Ideal in this manner, until the team makes a decision about each Ideal and the decisions have been recorded on the Cross-Reference.

d. Transfer the degree of consistency rating for each Ideal onto Worksheet 2, the **Consistency/Priority Rating Summary**. Once it is completed, duplicate this summary sheet so that each team member has a copy.

Step 2. Reach consensus on the level of priority of each Ideal for action planning.

a. Each team member receives a copy of the completed **Consistency/Priority Rating Summary** (Worksheet 2), showing the degree of consistency for each Ideal. Working independently, each team member examines the consistency rating and makes a personal judgement about how much attention each Ideal should receive in the action planning.

Here, too, use a one to five rating scale:

5 = Highest priority for action

3 = Moderate priority for action

1 = Low priority for action

The priority rating should be based upon two factors: (1) the importance of the Ideal in meeting the needs of students in the school, and (2) the mathematics program's current degree of consistency with the Ideal.

For example, imagine that in the team's judgment, the assessment data revealed that Ideal A-3, "The curriculum content is balanced and comprehensive," has a consistency rating of 2. A member who feels this is an important Ideal might give it a high priority rating for action -- say 4. In this manner, each team member completes the **Consistency/Priority Rating Summary**, determining and recording the priority rating **he or she believes** each Ideal merits.

In this manner, each cluster member completes thc Consistency/Priority Rating Summary for all the Ideals their group evaluated and records the priority rating he or she believes each Ideal merits.

b. Once team members have given each Ideal a priority rating, they submit the results to a pair of team members who compile the data of the entire group and determine the **average priority rating** for each Ideal. (For convenience, round all averages to the nearest whole, rounding down at .5.)

c. The team records the **average priority rating** for the group in the priority column on Worksheet 2. In the next step, these results will be placed on the MAP Decision Matrix (Worksheet 3).

Step 3. Graph program strengths and Ideals for action planning.

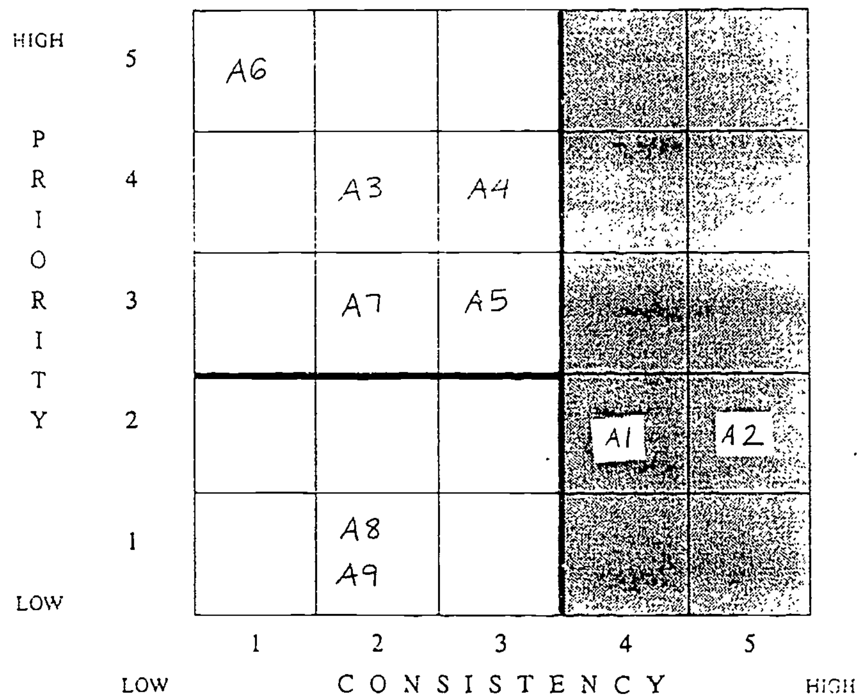
The MAP Decision Matrix (Worksheet 3) shows the team's findings in an easily read summary of the assessment process. The horizontal axis represents the degree of consistency of the school's mathematics program with each Ideal. The vertical axis represents the level of priority for action team members decided each Ideal deserves.

Using the data from the **Consistency/Priority Rating Summary** (Worksheet 2), plot each Ideal (labelling it with its Criterion letter as well as Ideal number) in the appropriate segment on the graph, as shown in Figure IV-1.

Figure IV-1.

Template for Worksheet 3
MODELS Decision Matrix

	Degree of Consistency	Priority
A1.	4	2
A2.	5	2
A3.	2	4
A4.	3	4
A5.	3	3
A6.	1	5
A7.	2	3
A8.	2	1
A9.	2	1



Once each Ideal is recorded on the Decision Matrix (Worksheet 3), the team has a graphic representation of the results of its assessment study. Interpret the graph as follows:

Program Strengths (right side) are the Ideals with which the school's mathematics program is most consistent.

Immediate Program Needs (upper left corner). The cluster's assessment data showed that the mathematics program was least consistent with these Ideals, and members agreed they should receive the highest priority for action planning.

Second Order Needs (the gray areas). The cluster's data indicated that these Ideals also received low consistency ratings and were deemed to be of low to moderate priority for action.

Once each Ideal number is recorded, the team has a picture of the major Ideals to emphasize and it is ready for action planning. Section V guides the planning process.

Modeling
Mathematics
Teaching
Excellence

WORKSHEET 1
CRITERIA AND IDEALS: CROSS-REFERENCE

A. CONTENT	MTI	MCO
A1. The curriculum provides a problem-based context for learning.	6 MTS	
A2. Mathematics problems occur in varied formats.	8 MTS SR	
A3. The curriculum content is balanced and comprehensive.	38	
A4. The curriculum develops number and operation sense.	1	
A5. The curriculum develops spatial and measurement sense.	2	
A6. The curriculum includes probability and statistics.	3	
A7. The curriculum introduces algebraic notions of variables, equations, and functions.	4	
A8. The curriculum emphasizes understanding of concepts and procedures.	5 MTS SR	32
A9. The curriculum is research-based and responds to a changing society.	57	

NOTE: *Abbreviations refer to the following Assessment Instruments: MTI = Mathematics Teacher Interview; MCO = Mathematics Classroom Observation. MTS = Mathematics Teacher Survey; SR = Student Resources for Learning Mathematics; SP = Statistical Profile*

B. INSTRUCTION	MTI	MCO
B1. Students actively engage in mathematics.	26 MTS SR	8 9
B2. Students discover meaning through manipulations with concrete materials.	7 MTS SR	33
B3. Students learn individually and in groups.	28 MTS	34 35
B4. Students construct meaning using a variety of resources and instructional materials.	58 MTS SR	10 11
B5. Instruction makes appropriate and regular use of technology.	23, 24 MTS SR	36 37
B6. Instruction balances new learning and review; classwork and homework.	59	12
B7. Supplementary programs and enrichment activities extend mathematics instruction beyond the classroom.	29 MTS	13
B8. Homework extends mathematics learning and applies new study skills.	37 MTS	

C. THINKING PROCESSES	MTI	MCO
C1. Thinking processes reflect multiple strategies for problem solving.	9	14a
C2. Teachers model problem solving.	10	15
C3. Students pose problems and discover solutions.	17	38 39
C4. The curriculum develops analytical reasoning abilities.	11 MTS	14b 16
C5. Students and teachers discuss mathematical ideas.	33	14c 17
C6. Students write and talk with one another about mathematics.	16 MTS	18 40
C7. Teachers clarify underlying concepts and listen to students' ideas.	60	19 20

85

D. DEVELOPMENTAL DIVERSITY	MTI	MCO
D1. All students, especially minorities, girls, and developing English speakers, have equal access to information, assistance, and classroom interaction.	30	21
D2. Teachers use fair and flexible grouping practices.	32	22
D3. Teachers accommodate special needs, abilities, and disabilities.	13	23
D4. Teaching strategies motivate underachievers.	12 MTS	
D5. The classroom environment invites participation by all students.	61	1 2 24
D6. Staff development and planning focus on the unique developmental needs of young adolescents.	48	

56

E. ATTITUDES	MTI	MCO
E1. Teachers believe *all* students are capable of mathematics achievement.	31	
E2. Students believe they can be successful in mathematics.	62	
E3. Students help develop high expectations and standards for themselves and others.	27	41
E4. The school recognizes and rewards the mathematics achievements of all students.	34	3 25
E5. Originality and accuracy in mathematics are both rewarded.	18	
E6. Students are free to make mistakes and are encouraged to take risks.	19	26
E7. The school encourages families to expect and support mathematics achievement.	39 MTS	
E8. School support personnel assist in promoting the mathematics program.	63	
E9. The community values mathematics achievement.	64 MTS	

F. RELEVANCE	MTI	MCO
F1. Teachers relate mathematics to individual interests.	14	27 28
F2. Imaginative uses of mathematics are stimulated.	65 MTS SR	4 29
F3. Mathematics is applied to the arts and sciences.	15	5
F4. The usefulness of mathematics is taught across subjects.	44	
F5. The program stresses the importance of mathematics in everyday life and in future career choices.	22	6 30

G. COLLEGIALITY	MTI	MCO
G1. The mathematics program has strong leadership and an effective, knowledgeable, and caring staff.	47 52	31 42
G2. The school and district support teachers' continuing education in mathematics.	51 MTS	
G3. The mathematics department conducts regular program reviews and plans in-service activities.	45 49	
G4. Interdisciplinary collaboration strengthens mathematics teaching.	42	
G5. Administrators encourage professional involvement.	50	
G6. Schedules enable collaborative planning.	43	

H. COMMUNITY	MTI	MCO
H1. Parents and community are involved in improving the mather atics program.	56 MTS	
H2. Parents are informed about the development and purposes of the mathematics program.	53	
H3. Parents are informed of specialized support and instructional assistance in mathematics.	54	
H4. Parents are informed of mathematics curriculum options and their consequences.	55	
H5. Parents and community participate in mathematics activities in and outside of school.	21 MTS	43

I. CONTINUING ASSESSMENT	MTI	MCO
I1. Individual student achievement is evaluated using multiple sources of data.	35 MTS	
I2. Students and parents receive constructive feedback.	40 MTS	
I3. Assessment sources address school, district, state, and national goals.	66 SP	
I4. Grading policies are clearly defined and consistently administered.	36	
I5. The mathematics program is evaluated using multiple sources of data.	41 MTS	
I6. Teachers in all subject areas participate fully in program planning and evaluation.	46	
I7. The middle-grades mathematics program coordinates with the mathematics programs in local elementary and high schools.	25	7
I8. The mathematics department monitors curriculum materials for bias.	20	

91

Modeling Mathematics Teaching Excellence

WORKSHEET 2
CONSISTENCY/PRIORITY RATING SUMMARY

Using the combined information from the assessment process, the team assigns each Ideal a consistency rating of one to five, using the following scale:

5 = Completely consistent with the Ideal
3 = Moderately consistent with the Ideal
1 = Inconsistent with the Ideal

The priority rating should be based upon two factors: (1) the importance of the Ideal in meeting the needs of students in the school, and (2) the mathematics program's current degree of consistency with the Ideal.

5 = Highest priority for action
3 = Moderate priority for action
1 = Low priority for action

A. CONTENT

Uses a problem-centered curriculum to develop students' conceptual understanding of mathematics, appreciation for its applications, and proficiency in computational skills.

CONSISTENCY	PRIORITY	
______	______	1. The curriculum provides a problem-based learning context.
______	______	2. Mathematics problems occur in varied formats and contexts.
______	______	3. The curriculum content is balanced and comprehensive.
______	______	4. The curriculum develops number and operation sense.
______	______	5. The curriculum develops spatial and measurement sense.
______	______	6. The curriculum includes probability and statistics.
______	______	7. The curriculum introduces algebraic notions of variables, equations, and functions.
______	______	8. The curriculum emphasizes understanding of concepts and procedures.
______	______	9. The curriculum is research-based and responds to a changing society.

B. INSTRUCTION

Engages students in a variety of learning experiences designed to promote mathematical exploration and reasoning.

CONSISTENCY	PRIORITY	
______	______	1. Students actively engage in mathematics.
______	______	2. Students discover meaning through manipulations with concrete materials.
______	______	3. Students learn individually and in groups.
______	______	4. Students construct meaning using a variety of resources and instructional materials.
______	______	5. Instruction makes appropriate and regular use of technology.
______	______	6. Instruction balances new learning, review, and homework.
______	______	7. Supplementary programs and enrichment activities extend mathematics instruction beyond the classroom.
______	______	8. Homework extends mathematics learning and applies new study skills.

92

C. THINKING PROCESSES
Develops students as problem solvers, critical thinkers, and effective communicators in mathematics.

CONSISTENCY	PRIORITY	
______	______	1. Thinking processes reflect multiple strategies for problem solving.
______	______	2. Teachers model problem solving.
______	______	3. Students pose problems and discover solutions.
______	______	4. The curriculum develops analytical reasoning abilities.
______	______	5. Students and teachers discuss mathematical ideas.
______	______	6. Students write and talk with one another about mathematics.
______	______	7. Teachers clarify underlying concepts and listen to students' ideas.

D. DEVELOPMENTAL DIVERSITY
Provides instruction and resources to meet young adolescents' diverse learning needs.

CONSISTENCY	PRIORITY	
______	______	1. Students have equal access to information, assistance, and classroom interaction.
______	______	2. Teachers use fair and flexible grouping practices.
______	______	3. Teachers accommodate special needs, abilities, and disabilities.
______	______	4. Teaching strategies motivate underachievers.
______	______	5. The classroom environment invites participation by all students.
______	______	6. Staff development and planning focus on young adolescents' needs.

E. ATTITUDES
Fosters positive attitudes about mathematics and encourages and recognizes students' accomplishments.

CONSISTENCY	PRIORITY	
______	______	1. Teachers believe all students are capable of mathematics achievement.
______	______	2. Students believe they can be successful in mathematics.
______	______	3. Students help develop high expectations and standards for themselves and others.
______	______	4. The school recognizes and rewards the mathematics achievements of all students.
______	______	5. Originality and accuracy in mathematics are both rewarded.
______	______	6. Students are free to make mistakes and are encouraged to take risks.
______	______	7. The school encourages families to expect and support mathematics achievement.
______	______	8. School support personnel (counseling staff, media specialists, etc.) assist in promoting the mathematics program.
______	______	9. The community values mathematics achievement.

F. RELEVANCE
Relates mathematical knowledge to students' interests, experiences, and future goals.

CONSISTENCY	PRIORITY	
______	______	1. Teachers relate mathematics to individual interests.
______	______	2. Imaginative uses of mathematics are stimulated.
______	______	3. Mathematics is applied to the arts and sciences.
______	______	4. The usefulness of mathematics is taught across subjects.
______	______	5. The program stresses the importance of mathematics in everyday life and in future career choices.

G. COLLEGIALITY
Inspires collegiality among faculty who work together to implement responsive programs for young adolescents.

CONSISTENCY	PRIORITY	
______	______	1. The mathematics program has strong leadership and an effective, caring staff.
______	______	2. The school and district support teachers' continuing mathematics education.
______	______	3. The mathematics department conducts regular program reviews and plans in-service activities.
______	______	4. Interdisciplinary collaboration promotes mathematics understanding.
______	______	5. Administrators encourage professional involvement.
______	______	6. Schedules enable collaborative planning.

H. COMMUNITY
Involves parents and the community in a collaborative effort to promote student competence in developing and using mathematical knowledge.

CONSISTENCY	PRIORITY	
______	______	1. Parents and community are involved in improving the mathematics program.
______	______	2. Parents are informed about the development and purposes of the mathematics program.
______	______	3. Parents are informed of specialized support and instructional assistance in mathematics.
______	______	4. Parents are informed of mathematics curriculum options and their consequences.
______	______	5. Parents and community participate in mathematics activities in and outside of school.

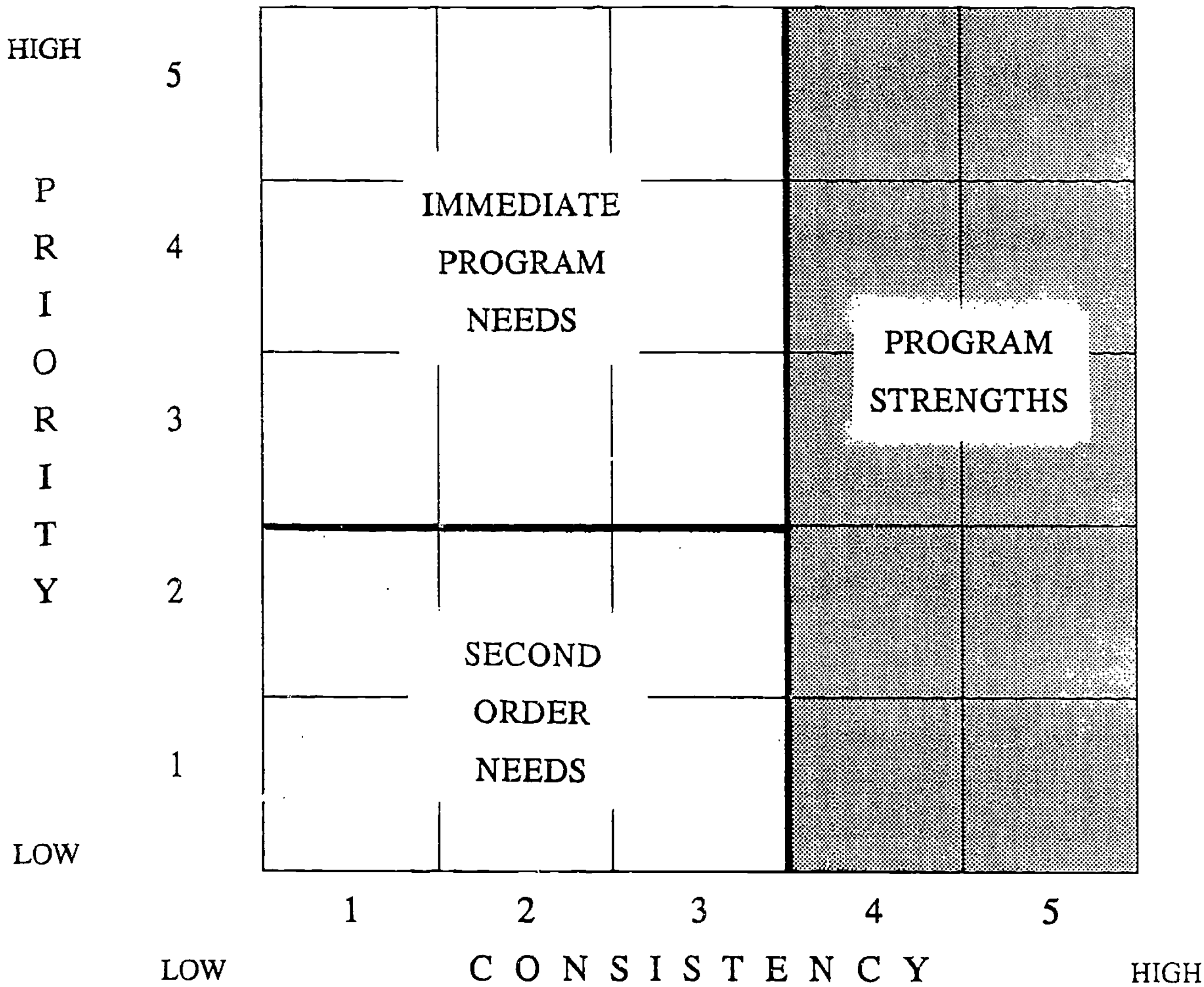
I. CONTINUING ASSESSMENT

Continually monitors student achievement, evaluates program effectiveness, and uses the results to determine the need for improvement.

CONSISTENCY	PRIORITY	
______	______	1. Individual student achievement is evaluated by multiple sources.
______	______	2. Students and parents receive constructive feedback.
______	______	3. Assessment sources address school, district, state and national goals.
______	______	4. Grading policies are clearly defined and administered consistently.
______	______	5. The mathematics program is evaluated through multiple sources.
______	______	6. Teachers in all subject areas participate in program planning and evaluation.
______	______	7. The mathematics program coordinates with the mathematics programs in feeder elementary and receiving high schools.
______	______	8. The mathematics Department monitors curriculum materials for bias.

95

Template for Worksheet 3
MODELS Decision Matrix

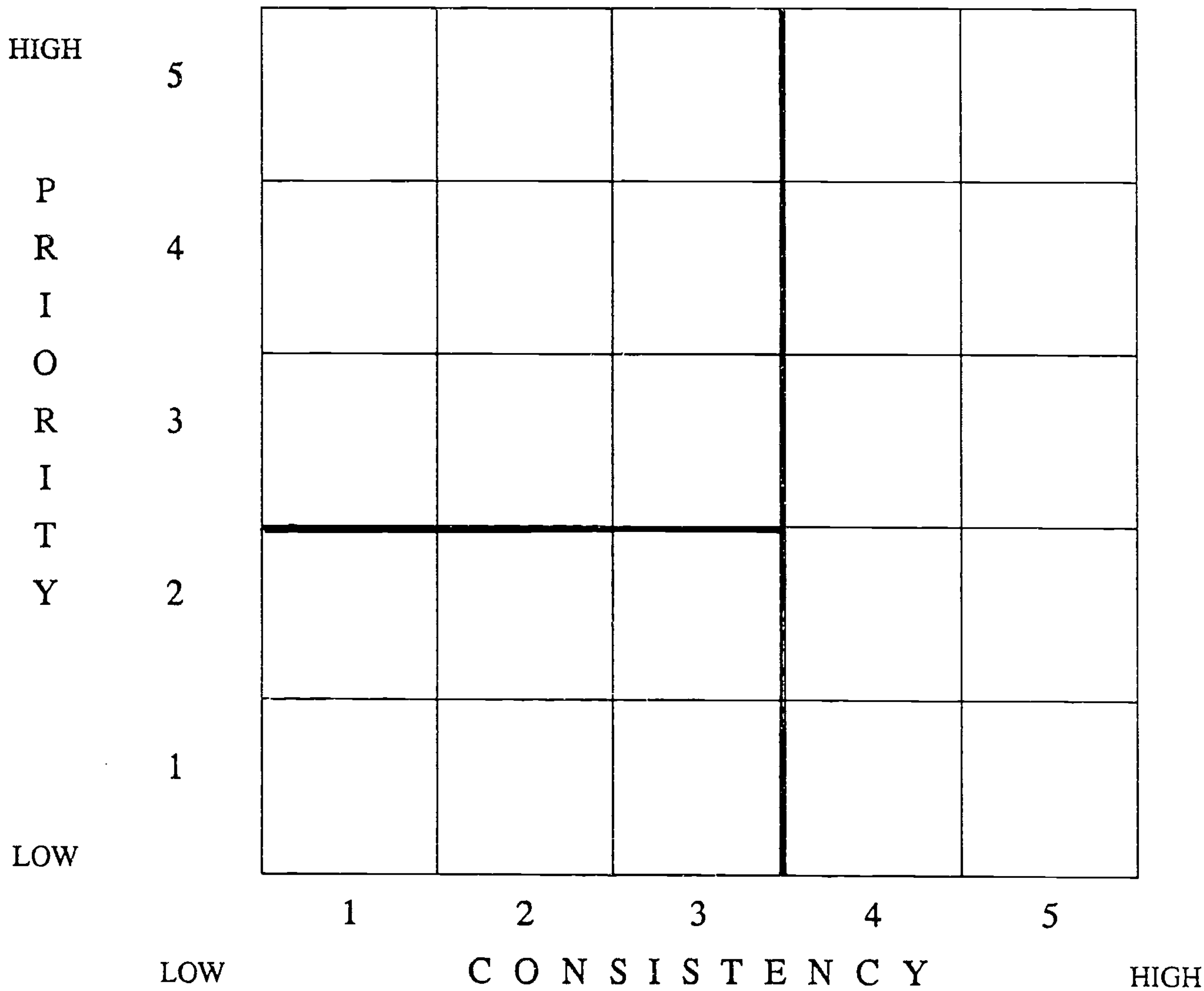


Program Strengths. These are the Ideals with which the school's mathematics program is most consistent.

Immediate Program Needs. This cluster's assessment data showed that the mathematics program was least consistent with these Ideals, and members agreed they should receive the highest priority for action planning.

Second Order Needs. The cluster's data indicated that these Ideals also received low consistency ratings and were deemed to be of low to moderate priority for action.

Worksheet 3
MODELS Decision Matrix



Program Strengths (right side). These are the Ideals with which the school's mathematics program is most consistent.

Immediate Program Needs (upper left). This cluster's assessment data showed that the mathematics program was least consistent with these Ideals, and members agreed they should receive the highest priority for action planning.

Second Order Needs (lower left). The cluster's data indicated that these Ideals also received low consistency ratings and were deemed to be of low to moderate priority for action.

Section V

Framework for Action Planning

MODELING MATHEMATICS TEACHING EXCELLENCE

Section V

Framework for Action Planning

This section provides a framework for action planning to initiate mathematics program improvement. The process is divided into three phases:

- Identifying mathematics program strengths and priorities for action planning
- Writing goals for action planning
- Action planning

Following action planning, the team, in collaboration with mathematics teaching colleagues and the school administration, begins to implement its plan. This section concludes with a discussion of implementation challenges. The guides at the end of this section provide a framework for action planning.

Identifying mathematics program strengths and priorities for action planning

Begin the action planning by locating the Action Planning Guides, Parts I and II. The action planing process uses these worksheets. Have extra copies available for team members' use.

The team begins its planning by listing the strengths of the program that were identified by the team on the Decision Matrix in the data analysis in Section IV.

Part I: Mathematics Program **Strengths**

Use the Action Planning Guide: Part I to record the program's strengths from the right side of the Decision Matrix. These were the Ideals with which the mathematics program was determined to be most consistent. Give one or two examples of the consistency next to the Ideal; indicate how the strength will be sustained in the months ahead.

This section of the action planning summarizes the <u>current achievements</u> of the school's mathematics program. The team should share these findings with administrators, parents, central office personnel, and visitors. By focusing attention on these positive assessment results, the school community becomes more aware of the successes of its mathematics program.

Part II: Priorities for Action

The Action Planning Guide: Part II will be used to itemize the Ideals that received high priority ratings for action planning during data analysis.

Begin by recording on large chart paper--so the list can be easily seen by all team members-- the Ideals that were identified as **first priorities for improvement** from the upper left section of the Decision Matrix. Next, discuss the second level priority items (lower left section) and itemize any **second priorities** that should be included as part of the action planning at this time.

Writing Goals for Action Planning

Each Ideal that will be in the action plan should be rewritten as a goal statement and recorded in the first column of Priorities for Action. This commits the team to include this goal in its action plan. List all the revised Ideals -- written as goal statements -- in the Priorities for Action.

Follow the example below to rewrite Ideals as goal statements that suggest action strategies:

1. Assume Ideal A-3, "The curriculum is balanced and comprehensive," had an consistency rating of 2 and a priority rating of 5, and the team agrees will be listed as an goal for action planning.

2. The team looks back at the questions that were asked about that Ideal and clarifies the ways in which the program was inconsistent with the Ideal.

3. Using the questions in the assessment instruments as a guide, the group revises the Ideal as goal statement. An example might be: "The mathematics department will update the school's curriculum to include more instruction on concept building, problem solving, and mathematical applications."

4. Record the new goal statement on the Action Planning Guide, Part II: Priorities for Action.

5. The team proceeds through the remaining Ideals, revising each one that will be included in the action plan as a goal statement. Record the new goal statements on the Action Planning Guide and note their levels of priority for action in the appropriate column.

6. Once the list of action goals are summarized and priorities are recorded, the team is ready to design a plan to meet its goals for improvement.

Action Planning

The following steps structure the action planning, using the Action Planning Guide: Part II - Priorities for Action. Also, this section concludes with tips for accomplishing the major action planning activities. Turn to them, as needed, to keep the team's thinking focused and action-oriented.

1. Agree upon the goals for action within each Criterion. Using one action planning page for each Criterion, list the goals in Column 1. For each

goal record in Column 2 the Ideal's priority rating. Use as many pages as necessary to list all of the team's priority goals. (See Figure V-1, Writing Workable Goal Statements.)

2. Brainstorm possible strategies for action for each goal. "Rules of thumb" for brainstorming are listed at the end of this section in Figure V-2. These guidelines will help generate a wide variety of possible action alternatives.

3. Agree upon actions to be taken to meet each goal, and describe the plans briefly in Column 3. (See Figure V-3 on Reaching Consensus.)

4. Identify the individual(s) who will be responsible for carrying out actions. Record their names in Column 4. As often as possible, designate two- to three-person teams to carry actions forward.

5. Specify the time lines and the dates by which actions will be taken. Record the approximate completion dates in Column 5.

6. List any special resources, additional assistance, or support the team will need to meet the goals for action. For each goal, record this information under the line at the bottom of the page of the Action Planning Guide on which it appears. (See Figure V-4.)

7. Double-check that you have completed all the steps to defining the action plan using Figure V-5, the Checklist for Action Planning.

Action planning should be an open-ended process, one based on a broad discussion of options. Be creative and original, but seek ideas that are practical and have good likelihood for success. Look back at the questions in the assessment instruments for suggestions of ways teachers extend innovative practices. Whenever possible, the team should seek out new ideas, including those that have previously met with faculty resistance and those requiring special funding.

This is a time for new visions and for planning changes. An action plan that represents a blend of the practical and Ideal is one that will most likely move the school forward and engage the broadest support from colleagues, students, and parents.

First explore ways to meet the action goals without additional resources. Team members will find many no-cost and simple ways they can adjust their current practices to bring them in line with the Criteria for Excellence, for example, working collaboratively, using the ideas included in MAP instruments or in the NCTM *Curriculum and Evaluation Standards*. Other examples include using cooperative learning, routinely encouraging students to evaluate their own work, and expecting students to write about and demonstrate their mathematics thinking on a daily or weekly basis.

Action items should include plans that teachers can implement individually, in their own classes, and with other team members. Many schools have resources that one or two teachers use often, but others do not know are available. Provide time to share these resources by team teaching or by having after-school sharing sessions. Include some planned changes that require additional resources or cooperation and support from administrators.

As your team conducts its planning, consider these issues:

What instructional and organizational changes will bring our school's mathematics program into alignment with the Criteria and Ideals?

To accomplish our proposed changes, what specific aspects of the current program do we want to recommend restructuring or revising?

What alternatives were suggested during the data gathering phase and what are some new approaches to tackling old problems?

Have we involved everyone on our team in the action planning process, giving each individual a significant role in the implementation of action?

The process outlined above will proceed differently in each school. It can be modified, as necessary, to suit special circumstances. A number of factors will affect the action planning process, and teams should acknowledge these as strengths or limitations as they go forward.

They include the following:

- The amount of time team members have to meet and reach agreement about plans.
- The degree of similarity or difference among teachers' current practices.
- Teachers' familiarity with the developments in mathematics education and the concepts described in the Criteria for Excellence and in the NCTM *Standards*.
- Team members' prior experiences as planners.
- Availability of resources and support from colleagues and parents within the school and from consultants, administrators, or central office personnel to plan program changes.

Above all, be positive. Try to accomplish as much as possible, but do not be unduly critical if every goal is not achieved.

A well-written plan takes time to think through, much candid discussion among colleagues, and collaboration. Most important, the team should strive to design a plan that is practical, but one that stretches them to some extent.

Plans for altering programs should come out of brainstorming sessions and discussions that seek a "sense of the group" about reasonable actions to be taken by individuals and the staff as a whole. Avoid using a "majority rules" approach. Instead, try to make action planning a means of reaching mutually agreed upon points of view that everyone can accept. Where there is strong disagreement, it may be useful to temporarily table the issue rather than to try to force artificial consensus. Alternatively, you might try out a solution for a limited period, testing its feasibility, before the entire group actually commits to it.

Implementation Challenges

The implementation of the action plan should begin as soon as possible. However, before going very far, it is beneficial to distribute copies of the plan and to discuss it in some depth with members of the mathematics department who did not participate in the assessment process. Also, faculty members in other departments should be informed of the team's work and its future plans.

Thus, immediately after the assessment team has finalized a draft of its Action Plan, disseminate it to members of the mathematics department. Discuss suggestions for revisions, and agree upon procedures for presenting the plan to the administration, the faculty, and, eventually, to members of the community and the central office staff.

Once the plan is finalized by the assessment team and approved by the entire mathematics department, decide upon a strategy for disseminating it to the faculty and to other key stakeholders (central office administrators, parents, etc.) in the school community. Finally, determine key dates for monitoring the implementation of the plan.

It should be possible to begin implementating the assessment immediately. Plans, time lines, and responsibilities are clearly delineated. The challenge ahead is to turn a vision into reality.

The questions in the MAP instruments themselves contain many ideas for improving and expanding the ways teachers routinely teach. Manipulative materials, computers, calculators, and alternative evaluation methods were suggested throughout the instruments. Some additional staff development about new expectations, curriculum materials, and instructional approaches will be likely to use some of the ideas suggested. Plan to incorporate other changes in the ways that the mathematics department plans and works together, or in the types of assignments or evaluation procedures the department uses with its students. Small adjustments in attitudes, expectations, and process, when carried out collaboratively and by all teachers, may have a powerful long-run impact on the overall program and the quality of student's mathematics learning.

Implementation of an action plan will likely be an uneven process, taking several years. Its success relies especially on a strong, collegial team. The team has completed a project from which it probably learned important lessons about the benefits of cooperation and mutual support. If this is true, team members will spontaneously begin to work together and to rely upon one another increasingly.

Continuing faculty leadership and collaboration are essential. Changes will most likely take root if the spirit of collegiality continues during the implementation phase.

Most importantly, the implementation of a new kind of mathematics education program must be one that focuses on students. Encourage team members to concentrate on ideas that respect the complexity, vibrancy, and potential of young adolescent learners. Any successful middle-grades mathematics program begins with the needs of young adolescents and it ends there, as well. Ultimately, it is the students who will demonstrate the wisdom and efficacy of the process.

Figure V-1

WRITING WORKABLE GOAL STATEMENTS

Do our action goals meet the following standards?

- **Are they clearly stated?**
- **Are they simple and direct?**
- **Can they be accomplished with reasonable support?**
- **Are they agreed upon by all team members?**
- **Are they specified in priority order?**

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Figure V-2

BRAINSTORMING GUIDELINES

- **Encourage each person to suggest every idea that comes to mind.**
- **Record each idea as it is stated (no editing!).**
- **Move rapidly -- details are not necessary.**
- **Build on one anothers' ideas.**
- **Set a time limit (5 - 10 minutes) and generate as many ideas as possible during that period.**

REMEMBER:
DO NOT DISCUSS, CRITIQUE, OR REJECT ANY IDEAS DURING THE BRAINSTORMING PROCESS.

Figure V-3

REACHING CONSENSUS

- **Ask one person to summarize the issue being discussed.**
- **Ask individuals to clarify or explain their positions.**
- **Discuss alternative points of view - emphasizing pros and cons.**
- **Summarize the various ideas in writing.**
- **Revise ideas and include suggested modifications that group members agree upon.**
- **Rewrite a comprehensive statement that represents the consensus.**

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Figure V-4

DETERMINING RESOURCES AND ASSISTANCE NEEDS

- What kinds of resources are needed to implement our team goals, e.g. human resources, staff development, new materials, consultant support?
- What are possible sources for obtaining them?
- Are funds needed? If so, where might they come from?
- Which colleagues have expertise they could share?
- Are there people in the school, the central office, or in the community who can provide the resources to assist without cost?

AS MUCH AS POSSIBLE, THE GROUP SHOULD ANSWER SOME OF THESE QUESTIONS DURING THE PLANNING PHASE SO THAT RESOURCE LIMITATIONS ARE NOT OBSTACLES TO PROGRAM IMPLEMENTATION.

Figure V-5

CHECKLIST FOR ACTION PLANNING

Does our plan of action include the following elements?

- **Clear, specific goal statements, with priority commitments that we can reasonably expect to achieve within the next year or two?**
- **Practical suggestions that will help accomplish each goal?**
- **Individuals designated to lead us in meeting our goals?**
- **Realistic time lines and dates for completion?**
- **The resources and assistance the mathematics department will need to implement the goals?**

h____________________

port Date ____________________

Criteria:

ACTION PLANNING GUIDE: PART I

Mathematics Program

Strengths

Consistent Criteria and Ideals	Examples	Continuation Plan
109		110

School ____________________

Report Date ____________________

Criteria:

ACTION PLANNING GUIDE: PART II

Priorities for Action

Ideal Stated As Goal	Priority	Actions To Be Taken	Who is Responsible	Time Line

Resources and Assistance Needed

111 112

Appendices

GLOSSARY

Abstract	Abstract concepts or ideas are constructed in a person's mind on the basis of personal experience with concrete objects or pictorial representations. An abstract mathematical concept is presented or explained using materials or pictures that exemplify the concept.
Algebra-related manipulatives	Algebra-related manipulatives are manipulative materials specially designed to bridge the gap between the concrete world of number and the more abstract, symbolic world of algebraic notation. These include Algebra Tiles, Algebra Lab, and Dienes' Algebra Experience Materials.
Algorithm	An algorithm is a routine procedure followed in order to solve straightforward mathematical problems. Different algorithms may be used to solve the same problem.
Alternative algorithms	Alternative algorithms are different methods for solving mathematical problems. Middle school students particularly appreciate having a choice of methods.
Applications	Applications use previously learned skills to solve problems based on concrete situations. These problems may be either routine or non-routine.
Arithmetic calculators	Arithmetic calculators are calculating tools which perform the four basic arithmetic operations, as well as find values of square roots, powers, and logarithms.
Assessment techniques	Assessment techniques vary widely, ranging from individualized to group-administered, criteria-referenced to norm-referenced, formal to informal, instrument-based to observational techniques.
Attribute blocks	Attribute, or logic, blocks are manipulative materials which are used for sorting and classifying activities. A basic set consists of sixty-four blocks of four shapes, four colors, two sizes, and two thicknesses.
Base ten blocks	Base ten blocks are classroom materials modeling the base ten numeration system. Base ten blocks embody place value relationships and are used to model addition, subtraction, multiplication and division of whole numbers and decimals.
Chip trading sets	Chip trading sets are manipulative materials often used to demonstrate and work with concepts of place value. Chips, colored to denote denominations, are traded according to set rules.

Combinatorics — Combinatorial mathematics deals with the counting of selections (combinations) or arrangements (permutations) of elements from finite sets.

Cooperative learning — In cooperative learning, students work together in small groups to solve problems. The teacher constructs problems in which collaboration is helpful. Research suggests that girls and minority students especially benefit from working in cooperative learning groups.

Computer spreadsheets — Computer spreadsheets are computer programs set up to perform calculations on data. Spreadsheets can be used effectively in middle school mathematics and computer courses.

Concepts — Concepts are ideas which are abstracted from experiences. Concepts are acquired through activity and are based on repeated experience and reflection.

Concrete — Concrete understanding is based on physical models or real world objects. A concrete experience is one which is real and palpable. In classrooms the use of concrete materials helps students understand the abstract concepts which underlie much of mathematics.

Constructivism — An educational philosophy and approach embodying the following three principles. (1) Essential knowledge does not consist of facts but of specific conceptual structures linked by specific relations. (2) Conceptual and relational knowledge is not a commodity that exists outside people's heads and can simply be transferred to students by means of telling; it is something that must be built up by each individual, and language can do no more than orient a student's thinking in a certain direction. (3) Knowledge, including scientific knowledge, is not a collection of timeless truths about the world but a way of approaching and seeing experience. And, in order to reflect upon experience, students must be given opportunities to have experiences.

Criterion-referenced test - (CRT) — A criterion-referenced test evaluates an individual's performance with reference to specific objectives in various skill areas. Criterion-referenced tests compare an individual's performance with objectives rather than with a group.

Critical thinking — Critical thinking involves an understanding of the relationship of language to logic, leading to the ability to analyze, criticize, and advocate ideas, to reason inductively and deductively, and to reach factual or judgmental conclusions based on sound inferences and experiences.

Cuisenaire rods — Multicolored, multilength rods used for a variety of mathematical activities. Can be used to emphasize spatial reasoning skills, reinforcing such concepts as area, perimeter and volume, fractions, or whole number operations.

Data analysis skills — Data analysis skills involve the ability to analyze raw data in order to understand what the data show. These skills include the ability to interpret representations of data as well as the ability to collect and construct meaningful representations of data.

Databases — Databases are computer programs that manipulate stored collections of data by performing sorting or ordering operations according to specified characteristics.

Discrete mathematics — Discrete mathematics deals with ideas that can be modeled using distinct, countable objects. Topics in discrete mathematics include logic, combinatorics, networks, and basic principles of computer programming.

Drill and practice software — Drill and practice software is designed for the practice of particular computational skills. Generally such programs encourage automaticity of responses by regulating time and controlling the level of difficulty of presented problems.

Estimation — Estimation is the skill of making a sensible guess based on logical analysis of a situation. Estimation skills involve many judgments and higher order thinking. They can be applied in either the spatial or numerical domains.

Fraction bars — Fraction bars are cardboard strips colored to represent fractional parts of a whole. They are used to teach equalities, inequalities, addition, subtraction, multiplication and division of fractions in a relatively concrete mode.

Geoboards — Geoboards are boards with nails inserted in a grid pattern at regular intervals. Used with elastic bands to construct 2-dimensional shapes, they are valuable tools for developing concepts of shape, angles, measurement, number patterns, area, geometry, and vectors.

Geometric construction materials — The traditional tools for performing two-dimensional geometric constructions are the compass and straightedge. Protractors, for measuring angles, are also used in creating pictorial representations of geometric ideas.

Geometric models — A wide variety of materials are available to illustrate geometric ideas such as shape, measurement, tessellation, space-filling curves, symmetry, congruence, similarity, and angle measure. These include geoboards, tangrams, D-stix, polyhedron models, pattern blocks, and many others.

Geometry — Geometry incorporates the study of objects, motion, and relationships in a spatial environment.

Higher order thinking skills — Higher order thinking skills are used to develop, articulate, test, and compare the results of different strategies, and to generalize the use of concepts and strategies in various situations. They are contrasted with more routine skills such as memorization.

Heuristics — Heuristics are general strategies used for solving complex mathematical problems. Unlike algorithms, heuristics do not guarantee solutions. Rather, they are techniques, such as drawing a diagram or making a chart, that are helpful in solving a problem.

Informal diagnosis — Informal diagnosis of a student's mathematical understanding can be made from classroom observations, clinical interviews, or other anecdotal evidence, such as parental reports.

Interdisciplinary unit — An interdisciplinary unit is a unit of study which draws from more than one academic discipline and develops thematic content related to more than one content area. An interdisciplinary unit might be simultaneously taught by teachers in two or more content areas.

Logic — Formal logic is a science dealing with the rules of sound thinking and proof by reasoning. Before the rules of this science are learned, however, students learn to think logically based on their own interpretation of experience.

Manipulatives — Manipulative materials are concrete models useful in representing various mathematical concepts. They typically appeal to several senses, and can be touched and moved around by students as they experiment and explore various mathematical ideas.

Mathematical models — Mathematical models are concrete or pictorial representations of various mathematical concepts. For example, Cuisenaire rods are a model of the number system; Fraction Bars are a model of fractions. These representations are used as tools with which to think.

Mental computation — Mental computation is a method of thinking through a problem, performing an operation, or obtaining a result without using pen, paper, or other concrete aids.

Metacognition — Metacognition is thinking about thinking, in particular, the uses and limitations of various thinking strategies.

Multibase blocks — Multibase blocks are blocks which are structured to develop students' understanding of our base ten numeration system by generating different representations for the same number using different bases for numerations.

Nonroutine problem — A nonroutine problem is one for which a student does not have a previously established routine or procedure for finding a solution. Some nonroutine problems have multiple solution strategies; some do not.

Norm-referenced tests - (NRT)
Norm-referenced tests evaluate a child's performance with reference to the performance of a specific sample of students. Scores are often reported as a percentile figure, indicating that the child performed better than a given percentage of the students in the sample.

Open-ended question
A question is open-ended when it does not require a given, specific answer as the solution. By showing students that there may be several ways to arrive at a solution, these problems support and encourage creativity.

Overhead calculators
Overhead calculators are transparent calculators which project the display and keyboard onto a screen by use of an overhead projector. They allow an entire class to view the operation of the calculator simultaneously.

Pattern blocks
Pattern blocks are colored blocks that can by used to model geometric relationships such as patterns, symmetry, congruence and similarity. They are often used to develop fraction concepts.

Problem solving
Problem solving is the process of applying previously acquired knowledge to new and unfamiliar situations. The methods, procedures, strategies and heuristics students use for solution often form the focus of a problem-solving lesson.

Problem-solving software
Problem-solving software is computer software which facilitates and supports problem solving. This software is often developed to support higher order thinking skills.

Problem solving strategies
See Heuristics.

Recitation
Recitation is a form of classroom interaction characterized by repeated sequences of teacher questions followed by student answers, in which students respond with information they have committed to memory.

Simulations
Simulations represent abstractions of some properties of behavior of a physical system into a model. This model is often manipulated by means of computer operations. A simulation may be used to analyze the effect of actions on that system.

Spatial abilities
Spatial abilities encompass many aspects of interpreting our environment, such as interpreting and making drawings, forming mental images, and visualizing movement or changes in those images.

Standardized diagnostic test
A standardized diagnostic test is intended to reveal strengths and weaknesses in basic scholastic concepts and skills. Standardized tests are presented in the same format to each student who takes the test.

Statistics — Statistics is the branch of mathematics dealing with the collection, organization, interpretation, and evaluation of (usually numerical) information. Statistics is an important tool for the analysis of trends and the study of populations.

Technology — Technology is the application of scientific methods and materials to achieve industrial, commercial, or educational objectives.

Tessellation drawing paper — Tessellation drawing paper is drawing paper which is pre-ruled to facilitate students' exploration of the tessellation of shapes.

Thinking processes — Thinking processes that are essential in the learning of mathematics include such processes as generalizing, abstracting, reversing, unitizing, and transitivity.

Thinking software — Thinking software is software which encourages the development of thinking skills and problem solving.

Tiles — Tiles are square materials which help children explore counting and number concepts, number patterns, basic operations, and multiples.

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