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Collaborating With Colleagues To Improve Student Learning Using The Connected Mathematics Project

Margaret D. Seifer

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To
Improve Student Learning
Using
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by

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*******ABSTRACT*******

I am a teacher of mathematics at Millburn Middle School, Millburn, New Jersey. During my nine years at Millburn, I have taught using the Connected Mathematics Program (CMP) for seven years to eighth graders and before that, I taught CMP in it's pilot stage to sixth graders.

This guide is a result of my thinking and learning during my time at Bank Street College. The guide is based on a journey through my learning as a professional developer. It is a tool which, I hope, will be of some use to other CMP leaders. It is hoped that if such a tool proves useful, that leaders will "pass the torch" to future leaders so they too may facilitate professional development opportunities for CMP for other new users.

This guide is in the public domain, and copies may be freely distributed among teachers and teacher leaders using CMP.

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*****INTRODUCTION*****

This independent study and learning on the part of the author occurred while helping new teachers. It is an attempt to understand the needs of a teacher while implementing the Connected Mathematics Project (CMP) for the first time. This document was created "after the fact" in order to recount the journey that this learning followed.

This document contains a detailed guide for workshop facilitators as well as handouts and other resources for helping teachers. It is particularly for those teachers and teacher leaders who plan to prepare to give a workshop during the summer prior to the first year of implementation. It may prove especially helpful to those with little or no experience in professional development or consulting. In such a case, knowledge of CMP and it's content by having previously taught it and the desire to help other teachers is all that is needed.

The main part of this document contains several sections. The first part, entitled, "Rationale," explains my thinking during the week-long professional development experience and ultimately the creation of the workshop leader's guide. Part two, "Review of Research Literature," offers insights from those expert professional developers and curriculum developers whose work I have studied in great detail during my time at Bank Street. The next section of this paper, "Discussion," is a short conclusion which discusses how the rationale behind this study changed over the course of its development and ultimately resulted in a final draft of the workshop leader's guide. The final section of this paper is the actual "Workshop Leader's Guide."

The appendices are intended as reference material for those who would be interested in facilitating and leading such a workshop. Appendix A is a collection of materials and handouts, which may prove useful to attendees of a given workshop. Appendix B is a lengthy set of notes for new teachers to CMP including details and reminders for every Investigation in each of the twenty-four units. Appendix C lists all books and articles, which contributed to the thinking behind the guide's development. The majority of books and articles quoted are CMP related/PD related while the remainder are mathematical in their discussions.

The first version of this guide was created a number of years ago. It was begun as an independent exercise solely for my own enjoyment, without regard at the time to how others may find it useful. It has since been adapted and edited in order to be shared with any colleagues who may find it helpful in their own work with the Connected Mathematics Project.

The Workshop Leader's Guide represents, in my opinion, my most valid independent study possible. It was begun as a purely personal exploration into CMP and professional development. Throughout this exploration, I have found myself a budding expert in the content, organization and activities of CMP. I have managed to use my enthusiasm for this learning to become quite adept at providing professional development opportunities and supporting teachers through their CMP journey, two subjects I hardly knew existed prior to my work at Bank Street College. I hope and plan to continue to explore these areas long after my formal attendance has been completed.

This guide is not copy-protected in any way. CMP teacher leaders are invited to explore where they may, with my invitation extended to share their developments, feedback and findings from their experiences.

I wish to thank Dr. Barbara Dubitsky, for her gentle encouragement and enthusiastic suggestions for improvement, throughout this course of study. Thanks are also offered to the promising CMP teachers who participated in the summer workshops of 2002, 2003, 2004 and 2005 for their assistance as "students" in working out the kinks within this guide.

*****RATIONALE*****

During the summer of 2002, I had my first opportunity to work with several teachers from districts across New Jersey who would be implementing the Connected Mathematics Project for the first time in the upcoming school year. I asked myself three questions.

1.) What would teachers need to know in order to understand the curriculum before the first year of implementation?

2.) What did I wish that I had in the way of professional development prior to my own implementation of CMP?

3.) What mistakes did I make while implementing CMP which I could now learn from?

I set three goals for the participants.

- Teachers of mathematics should become reflective practitioners who continually evaluate the effects of their choices and actions on others and should actively seek out opportunities to grow professionally.
- Teachers should examine and revise their assumptions about the nature of mathematics and how it is learned and should be taught, and then should experiment thoughtfully with alternative strategies in the classroom.
- Teachers should accept their professional responsibility to be on-going, self-directed learners of mathematics in order to continually develop and refine practices that attend to the mathematical needs of students.

I thought about what teachers would need to learn about mathematics in order to make sense of children's understandings and facilitate discourse to further children's mathematical thinking.

I wanted to provide the participants with opportunities to do mathematics together, explore how children's mathematical thinking develops by examining student work, and think about the nature of Standards-based instruction and how it differs from a procedural approach to mathematics education. Participants should consider the implications of these changes including professional development, assessment, questioning, and communication in the classroom. I also wanted to be sure to provide an atmosphere where teachers could engage with each other in substantive and intellectually critical examination of learning and teaching.

The National Middle School Association says that, "Quality teachers must have content knowledge and know how to teach that knowledge to young adolescents. Focusing exclusively or predominantly on content knowledge, at the expense of professional preparation "methods" training, will be less effective in the overall learning of middle level students" (2002). My short-term goal was to design an experience similar to the style of the Integrated Mathematics trilogy, but centered around CMP.

My long-term goal is to support school districts in building an effective mathematics education program using curriculum materials such as CMP, developed in response to the NCTM's Curriculum & Evaluation Standards for School Mathematics. In other words, I want to continue to support implementation of a mathematics curriculum framework (CMP) based on the NCTM Standards that will improve access to mathematics for all students.

I hope to excite teachers about new directions in mathematics education. However, new curriculum materials seem so different from current texts. Therefore, many teachers may be reluctant to embrace a curriculum like CMP. Professional developers, like myself, must create conditions that enable these programs to be used most effectively in schools.

I found that there were key elements in making a new standards-based curriculum a success for teachers. A valuable experience focuses on the design of professional development to support teachers in using the program effectively. This is an experience where participants will actively engage in student activities. Ultimately, this experience must build teachers' expertise with the programs' mathematics content and teaching strategies.

*****REVIEW OF RESEARCH LITERATURE*****

Many studies have been published about the need for professional development for teachers using new curricula. Many books, articles, and websites suggest that finding time for teacher preparation is difficult, yet necessary. "Tasks that encourage reflection take time" (Hiebert, 1997). In other countries, "Teachers study textbooks very carefully; they investigate them individually and in groups, they talk about what textbooks mean, they do the problems together, and they have conversations about them" (Ma, 1999). The time must be found for teachers to examine practices on, "how to support students as thinkers and creative problem solvers and how to help them learn important mathematics" (Hiebert, 1997). "Teachers are professionals: Not only are they responsible for choosing the system of instruction they will develop but also for making the day-to-day decisions about the way in which they will implement the system" (Hiebert, 1997).

I embarked on this study eager to examine how teachers learn and become acquainted with a new curriculum. I felt that researching a question regarding curriculum implementation would enable me to reflect on my own experience as a workshop participant and as a classroom teacher.

I was also interested in designing my own professional development opportunity for teachers keeping in mind what I wish I had had prior to implementing new curricula. Susan Loucks-Horsley admits in her foreword that, "Meaningful, well-crafted materials for use with teacher leaders are few and far between" (Miller, 2000).

As I continue this process through the next few summers, I hope that my research is helping me model many of the same practices with teacher-leaders that I use with

students. The relation between students and their teachers is probably one of the most important and influential factors in the effectiveness of a mathematics curriculum. Mathematics curricula must be presented by teachers who have a broad background and interest in mathematics, who recognize the important factors in individual and group learning, and who utilize a variety of appropriate classroom instructional strategies.

One of the teacher's most important jobs is to create a climate within the classroom that balances comfort and stimulation. This requires creating and maintaining an aesthetically pleasing environment in which to learn By addressing this issue with teachers, I hope that they will leave this week-long workshop feeling empowered, enthusiastic and confident after experiencing pleasure and success in the area of mathematics.

Just like our classrooms, the program built around mathematics should:

- Build a positive attitude and confidence that mathematical concepts can be mastered.
- Provide a conceptual development, which supports generalization of ideas.
- Provide an active learning environment with opportunities to experience the rewards of creative mathematical work.
- Build internal motivation that fosters success.

The central question that was the impetus for my study was, "How can I provide teachers with the support they will need to make a new curriculum work?" I was specifically interested in supporting teachers during the summer prior to the first year of implementing the Connected Mathematics Project. I wondered if there were any

opportunities available to teachers new to CMP. I also wondered if there was a demand for teacher support for those new to CMP.

There is a great deal of research about the need for professional development for teachers. Much of the literature in this area focuses on the need for building the teacher's own content knowledge. From my own experience, I have found that many middle level teachers do not have the mathematical content knowledge needed to teach middle school learners effectively. Now, both students and teachers are required to learn more mathematical content. Many studies cite this as one of the main reasons for the need to promote collaboration among colleagues.

However, even the CMP authors only dedicate one paragraph which suggests that, "Many teachers have found it valuable to plan with a colleague before, during, and after teaching the unit. Very often, student work is a focus for their discussions, as it provides a platform for discussing the mathematics in the unit, Investigation, or problem. Discussion can also cover effective teaching strategies and other issues related to teaching" (Lappan, 2002).

I teach mathematics to eighth graders using Connected Mathematics. This will be my tenth year in this setting. Issues regarding new staff, due to teacher turnover and increased enrollment, have arisen over the years. I became interested in the topic of professional development after new department members were hired to teach at my school with little or no experience or training in using Connected Mathematics effectively. I became curious about whether or not this was a problem in other districts as well. I wondered why this was so, and what, if anything, I could do to help in my own district and maybe beyond.

Michigan State University holds workshops entitled "Getting to Know the Connected Mathematics Project (CMP)" each summer sponsored by their department of Mathematics and Prentice Hall and in cooperation with The Show-Me Center at the University of Missouri. The workshop cost of $425 per person does not include travel costs, hotel stay or meals.

From the brochure, one may infer that even though participants have a choice of one of the seven workshops offered, they seem to be limited to studying only four or five units of the program. The conference agenda, found on the Connected Mathematics website (www.math.msu.edu/cmp/conferences/ national.htm) lists "Breakout Sessions" for almost the entire day. This is simply not enough. More is needed than just analyzing the program unit by unit.

Their goals include...

Learning more about the CMP curriculum-

- Mathematical content for the units
- Effective teaching strategies
- Assessment

Learning more about implementation-

- Management sessions
- Gaining support from parents and administrators
- Transitions from elementary to middle and middle to high school

"The teaching profession does not have enough knowledge about what constitutes effective teaching, and teachers don't have a means of successfully sharing such

knowledge with one another. To really improve teaching we must invest far more than we do now in generating and sharing knowledge about teaching" (Hiebert, 1999).

Typical adult learners have many stages of concern about change, which need to be addressed. Many teachers will be uncertain about the demands of this innovative curriculum and their own ability to meet those demands. They will feel overwhelmed at times and they will concentrate on the processes and tasks involved in implementing change and on how best to use both the information and resources that have been provided. Uppermost in their minds are issues related to efficiency, organization, scheduling and time management. Teachers will wonder how this change will affect their students. They wonder about the relevance this new curriculum will have for students' learning and assessment and how to increase students' performance. Teachers have a need to collaborate on the coordination of the program for change and are eager to share ideas with fellow teachers.

Workshop sessions should describe the pressures facing mathematics teachers and the challenging role and influence of teachers. A plan should be laid out to help teachers continue to be professionals, through planning, teaching, and reflecting, in order to develop more powerful mathematical understandings in the classroom.

One of the guiding principles in the Principles and Standards for School Mathematics (NCTM, 2000) is "The Teaching Principle." It states, "Effective mathematics teaching requires understanding what students need to know to learn and then challenging them to learn it well." The only way to improve student learning is with a knowledgeable and skillful teacher. Therefore, it is the teacher, what the teacher knows

and can do, that is the most significant factor in student achievement. Improve the teacher and you improve student learning (Sanders, 1996).

One of the major studies concerning professional development for teachers is that of the Third International Mathematics and Science Study (TIMSS, 1996). The study examined 42 nations and their attention to mathematics teaching and learning. The results showed that the demands made by school mathematics programs in the United States are not as challenging as in many other countries.

Another TIMSS finding related to teaching, is the lack of structured support that American teachers have for improving their pedagogical practice. Data has indicated that teachers here do not have much time or structured opportunity for interaction with colleagues about instructional issues.

New curriculum materials for the middle grades, like the Connected Mathematics Project, are more focused, and include demanding mathematical topics, many of which are contextualized in interesting and engaging ways. Ambitious goals are set for students as they attend to an appropriate mix of important mathematical topics. The Connected Mathematics Project also engages students in cognitively demanding activities where they are challenged to think and reason, to solve complex problems, and to communicate their ideas.

More ambitious curriculum is closely tied to more complex teaching. Once these materials are in the hands of teachers, mathematical teacher leaders need to take steps to ensure their informed and effective use in order to promote increased student achievement. "A substantial investment needs to be made in teacher professional development in order to support a more ambitious curriculum and more intellectually

challenging mathematics instruction, which in turn will lead to greater student achievement" (Beaton, 1996). Teachers need to learn to help students deal with complex mathematical tasks which require a style of engagement and interaction different from activities on a lower cognitive level.

Both initial preparation and ongoing professional development support are critical to the successful implementation of a more ambitious mathematics curriculum, like CMP, in the middle grades. We need not only to enhance teachers' knowledge of mathematics content and pedagogy, but also to provide specific support for their efforts to teach mathematics in better ways in the classroom.

The topic of Professional Development for teachers is also included on the CMP website. I have found this section of the website to be very useful throughout this research process (www.mth.msu.edu) This site has many links under the title of "Professional Development." It contains links to publications, organizations and useful information for teachers. Suggestions of strategies teachers can use to help promote effective classroom practices are given. Questions for teachers to think about to help address student needs are also provided.

When I wrote the first draft of this study, I had just begun some explorations involving engaging teachers in student activities. When I examined my notes, I noticed that teachers rarely have these kinds of opportunities to learn mathematics topics in an innovative way. Teachers often find such explorations extremely challenging.

I became deeply concerned with the lack of professional development opportunities for new users of CMP and believed that I had a responsibility to address the

issue. "Change leaders work on changing the context, helping create new settings conducive to learning and sharing that learning" (Fullan, 2001).

I faced, "an important challenge – how to help teachers in all classrooms become more effective in their teaching of mathematics. Staff development seminars can help teachers think in new ways and offer them improved instructional strategies and approaches" (Burns, 1999).

There are three key elements to effective workshops. (Loucks-Horsley, 1998)

1.) Leaders should communicate clearly stated goals with participants taking into consideration input from learners in order to address needs.

2.) The leader or facilitator should guide and support the participants' learning by being a primary source of expertise.

3.) Time frames, frequencies, and group structures should be well defined.

Loucks-Horsley encouraged me to reflect on my own practice as a professional developer. The power of professional communities to support instructional innovation has been seen clearly in my experience in schoolwide, districtwide and regional improvement efforts. "Collaborative cultures are innovative...because they provide support" (Fullan, 1999). Thus, it is critical that special attention be paid to nurturing and sustaining professional communities in which enhanced practice can be developed and supported. "Working alongside their peers, with the guidance of an experienced facilitator, individuals can gain richer insights into what makes a task challenging, how classroom events influence the unfolding of tasks, and ways in which one can productively reflect on one's own practice" (Stein, 2000).

*****DISCUSSION*****

Before I began my research, I had many questions about how to conduct meaningful professional development experiences for schools implementing new standards-based curricula. It was suggested that I narrow my focus in order to make the study more manageable.

As I gathered data, the connection with The Connected Mathematics Project seemed worth pursuing, especially since my home school district had implemented the new curriculum with no professional development opportunities and CMP was such a big change from our previous "traditional" mathematics texts.

As a result of my study, I now have more questions and am aware of areas that merit further exploration. How can special education teachers be supported through the implementation process? How can technology be used to aid the development of both teachers and students throughout CMP? How can I help address parent concerns regarding their child's classroom? How can administrators support smooth implementation of a new standards-based curriculum? These areas all seem to merit further study. I am also interested in how CMP can be used in conjunction with Lesson Study to improve classroom teaching.

Looking at the data from my experience with my teachers, I found that they had many thoughts before teaching CMP. They told me their thoughts as I recorded.

- "It is going to be an improvement from our old text, but I am nervous about using such a different style book."
- "The program seems very wordy and difficult."

- "I am overwhelmed by how different it is and I'm afraid the kids won't learn it and I won't be able to teach it."
- "It will be difficult for me to change my way of teaching."
- "This new material means more work."
- "It will be much harder to teach and it won't include the basics."

After teaching using CMP for a few months, the same participants said:

- "It has been a great change. The students are much more engaged."
- "The kids are enjoying math more."
- "It really does work. The students are enjoying it and I love teaching it."
- "I like the lessons. They are easy to teach, but they take time to prepare."
- "We definitely selected the right program."
- "This new material is useful and interesting."
- "I love the way all the hands-on activities flow and cover a complete unit."
- "The students are really learning to think and write about math more than I ever thought possible."
- "Students are able to communicate mathematics. Students are better prepared to think."
- "The program focuses on conceptual understanding which is it's major strength. Kids are involved and enjoy the investigations.. They are finding patterns on their own and I encourage them to test their ideas which they are motivated to do. They are making their own discoveries."
- "The students are thinking differently. They are enjoying the program."

I wonder how my curriculum and pedagogy is contributing to teacher preparation, and whether or not it will have long-term effects as teachers enter the classroom. I wonder how their experiences this summer will have an impact on their future work as mathematics educators. Have I provided the teachers with the foundation that enables and encourages them to be reflective practitioners?

Workshop Leader's Guide to *Connected Mathematics*

Contents

Workshop Leader's Guide to Connected Mathematics

To the Workshop Leader

Welcome to *Connected Mathematics,* the program that helps you meet the new challenges and demands in mathematics education. The *Connected Mathematics Project* was developed in conjunction with the National Science Foundation (NSF) at Michigan State University.

As you know, the NCTM Standards call for changes, not only in mathematics content, but also changes in teaching and learning. You and your teachers will discover that Connected Mathematics contains all of the elements that you need to implement the NCTM Standards.

The Workshop Leader's Guide will help you orient your staff to the program and to the expectations that you have for mathematics education in your district.

This Workshop Leader's Guide contains actual scripts for the workshop along with questions and notes. It is suggested that you use the materials interactively in workshops. Suggested discussion points for interactive presentations are included within the daily activities.

Please feel free to duplicate any of the materials that you wish to share with your administrators, teachers, and families.

Note to Facilitator:

In line with the National Council of Teachers of Mathematics Standards, this curriculum program aims to engage all students in learning challenging mathematics and becoming mathematically adept. Connected Mathematics emphasizes problem solving, communicating about mathematics, and making connections among mathematical ideas. The authors encourage students to have hands-on experience in doing mathematics and to learn how to use calculators and computers. This program challenges students to develop computational skills through problem solving, rather than as a prerequisite to tackling more advanced problems.

Most mathematics textbooks are developed by a publisher, produced and then tested by teachers and students as they are sold to schools. However, the Connected Mathematics Program (CMP) is different. This curriculum was developed by mathematicians and educators at leading research institutions using National Science Foundation (NSF) funding. This means that they have been held to NSF's highest proof of effectiveness – meaning the same level of proof as is required for new scientific information. None of the learning modules are ever released for general classroom use until years of actual classroom observation and revision by the authors has proven that the program works well and will help students master mathematics.

While most mathematics programs have merely made a few changes to appear to meet the high mathematics Standards developed by the National Council of Teachers of Mathematics (NCTM), Connected Mathematics incorporates these important Standards from the very beginning. Developed in response to the urgent, national need for improved student performance in mathematics, the NCTM Standards have helped kick-

start the movement for higher standards in the classroom. These Standards place great emphasis on real-world problem solving and understanding of concepts as the key to increased student interest and performance in mathematics.

Overview and Discussion Questions to Accompany Videotapes

Using the Videotapes

The videotapes can be used either in a continuous or in an interactive, stop-and-start mode. Suggestions for both methods are presented in this section.

Viewing Tips

1.) Be sure that room conditions are correct for viewing. Each person should have a clear, relaxed view of the screen. No glare should be present on the screen from any angle.

2.) Check the view from the farthest part of the room. The normal maximum viewing distance is eight times the height of the television screen. People viewing the programs from distances greater than recommended will be unable to see well and may become frustrated.

3.) Be sure there is good ventilation through the room.

4.) When asking participants to discuss questions, you may wish to have them work in pairs or small groups. With groups that are small or with participants who are very familiar with each other, whole group discussion is also an alternative.

Have a chalkboard, dry-erase board or flip chart available to record questions, comments, and concerns.

Week At A Glance

Day 1: Learning Groups & Understanding the Big Picture

- Introductions of Participants and Facilitator(s)
- Overview of the *Connected Mathematics Project*
- Try a Problem from *Connected Mathematics*
- "Hot Button Issues" about CMP
- *Connected Mathematics* Program and Philosophy
- Video – CMP in Ohio
- Group Management Techniques for your CMP Classroom
- Solve & Discuss a Problem from CMP
- Group Presentations and Discussion

Day 2: Details of Teaching a CMP Lesson

- "Hot Button Issues"
- Middle School Memories
- Video - MMM
- Solve and Discuss a Problem from CMP
- Planning to Teach a CMP Unit
- Break-Out Groups by Grade Level

  (Grade 6 – *Prime Time*)

  (Grade 7 – *Covering and Surrounding*)

  (Grade 8 – *Variables and Patterns*)
- Journals in CMP

Week At A Glance (continued)

Day 3: Assessment and Student Work

- "Hot Button Issues"
- Examine Student Work using Rubrics
- Assessment in CMP
- Break-Out Groups by Grade Level

  (Grade 6 – *Data About Us*)

  (Grade 7 – *Bits and Pieces II*)

  (Grade 8 – *Comparing and Scaling*)

Day 4: Management Techniques

- "Hot Button Issues"
- Management Techniques for Notebooks and Materials
- Video - MMM
- Break-Out Groups by Grade Level

  (Grade 6 – *Shapes and Designs*)

  (Grade 7 – *Variables and Patterns*)

  (Grade 8 – Moving Straight Ahead)

Day 5: Questioning

- "Hot Button Issues"
- Explore "The Peg Game"
- The Role of Questioning in the CMP Classroom
- Break-Out Groups by Grade Level

  (Grade 6 – *Bits and Pieces I*)

  (Grade 7 – *Stretching and Shrinking*)

  (Grade 8 – *Looking for Pythagoras*)
- Supplies and Support
- Closure

Day 1: Learning Groups & Understanding the Big Picture

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- Group Presentations and Discussion

Day 1: Overview of the Connected Mathematics Project

Rationale:

Welcome to this overview of the Connected Mathematics Project. Together, we will provide a look at the rationale behind the development of the program and the philosophy for the lesson design and content.

In recent years, there have been increased expectations from a variety of sources in mathematics education. The first group to express these raised expectations is society. It is clear that we need to prepare students for a life filled with information and technology. Parents want their children to do well in mathematics and be able to earn a living. They have a right to expect the best mathematics instruction possible. Industry has also set forth its expectations of the future. In the area of mathematics, they want prepared employees who are strong problem solvers. They must be comfortable working in groups to share ideas and knowledge. It will be important for the workforce of tomorrow to apply mathematical ideas to common and complex problems.

Test scores in the 1980s and 1990s also created pressure upon educators to improve the quality of mathematics instruction. "Average" students in other countries often learn as much mathematics as the best students in the United States. The Third International Mathematics Study demonstrated that the top 50% of Japanese students equaled the top 5% of students in the United States. Our very best students scored lowest of the top 1% of all students in the participating countries.

All U.S. students, regardless of their ability level, can and must learn more mathematics. Because of their raised expectations, new societal goals need to be set. Schools are being asked to provide a mathematically literate workforce.

The employees of the future must be mathematically competent problem solvers. We must prepare today's students to be lifelong learners. With rapid changes in technology and employment patterns, workers will change jobs at least four or five times in the next twenty-five years, and each job will require retraining. Because mathematics has become a critical filter for employment and full participation in our society, it is important for all students to have the opportunity to learn mathematics successfully.

As out students become informed voters of tomorrow, they will need to apply their critical thinking skills to read and interpret complex and sometimes conflicting information.

As the National Council of Teachers of Mathematics analyzed all of this information, they realized that mathematics courses in the 1990s must reflect a change. The new emphasis must include the topics and skills necessary for students to be successful in the future.

The Principles and Standards for School Mathematics emphasize major goals for mathematics education. Discuss the NCTM Standards. Show a copy of the Standards and ask the participants to suggest solutions to improve students' achievement in mathematics.

Students should have appropriate practice solving problems, and should be aware that all mathematics skills have problem-solving applications. They must develop strong math reasoning skills, which include computational competence and number sense.

Learning to communicate mathematically will help students to internalize and express their knowledge of concepts and skills. It is important for teachers to remember that what children learn depends on how they learned it.

In addition, it is important that students become confident in their ability to use mathematics and understand the value that mathematics can have in their lives.

In planning out lessons, we need to provide learning opportunities that will actively involve students in doing mathematics. Students learn mathematics by using such skills as exploring, constructing, predicting and describing.

Activity:

Discuss with participants forces of change and expectations that they believe are affecting their situation.

Resources:

- Copies of CMP Resources

Day 1: Try a Problem from Connected Mathematics

Rationale:

Because the student materials look quite different from a more traditional textbook or from the books used by the participants, it is important to have the participants engage in a problem from the CMP materials. This gives them a chance to experience the kind of mathematics that is being taught, as well as the depth of knowledge and reasoning that is required.

In *Covering and Surrounding*, students build a good understanding of the difference between perimeter and area by dealing with the concepts concurrently in a concrete, manipulative setting. They use square tiles to create designs to find areas and perimeters, and they transform designs to fit a prescribed perimeter or area.

In planning to teach a unit, the first thing a teacher needs to do is become familiar with the content and the way the concepts, reasoning, and skills are developed. It is important for participants to work through all problems in CMP as if they were the student. This helps to anticipate students' questions and where difficulties may occur. Teachers should ask themselves the following questions as they prepare to teach the lessons.

- What part of the main mathematical goal of the unit is being developed?
- How does this problem contribute to the development of the mathematics?
- What level of sophistication do I expect my students to achieve in answering the problems in the Investigation?
- How will student responses show development in understanding the big ideas of the unit?

- What connections can be made among the problems in this Investigation, to other Investigations in this unit, and to other units?

Activity:

Groups solve and discuss Problem 1.1 - "Designing Bumper Car Rides" from *Covering and Surrounding* Unit – Grade 6. In this problem students explore the different bumper-car floor plans that can be made from a given number of tiles.

This Investigation introduces students to area and perimeter by asking them to create floor plans for bumper-car rides made from 1-meter-square floor tiles and 1-meter rail sections. The floor tiles and rail sections allow students to count to find the area and perimeter of the plans. The name of the unit even binds the investigations together: covering (area) and surrounding (perimeter).

The problems present interesting and challenging tasks while offering opportunities for meaningful progress and learning by students of different aptitudes and prior achievements. The student edition strongly supports investigative classwork. The greatest learning will occur if students conduct some exploratory work of their own, discover strategies for themselves, and then share their findings.

Resources:

- Covering and Surrounding – student edition
- Calculators
- Square Tiles – 24 per Group
- Inch and Centimeter Grid Paper

Day 1: "Hot Button Issues"

Rationale:

Even if teachers are firmly committed to the innovation, their attention is concentrated on the processes and tasks involved in implementing change and how best to use the information and the resources that have been provided. Uppermost in their minds are issues related to efficiency, organization, scheduling and time management.

Activity:

Ask participant to think about issues they are struggling with. Encourage them to put their questions, ideas and concerns on post-it notes and display the notes on large chart paper. Assure the participants that these issues will be addressed throughout the week of training.

Begin an informal conversation about the components of CMP, covering topics such as review of the lesson design (LES), discussion of the mathematical reflections, using ACE problems, ideas on pacing, unit planning, management techniques, and contents of the website.

Resources:

- Post-it Notes
- Large Poster Paper
- Bright Color Markers

Day 1: CMP Program and Philosophy

Rationale:

Connected Mathematics is built upon the philosophy that, "All students should be able to reason and communicate proficiently in mathematics. They should have knowledge of and skill in the use of the vocabulary, forms of representation, materials, tools, techniques, and intellectual methods of the discipline of mathematics. This knowledge should include the ability to define and solve problems with reason, insight, inventiveness, and technical proficiency" (Lappan, 2002).

As teachers become more experienced, they increasingly recognize the importance of connecting the concrete activity through the pictorial level to the symbolic recording of the concepts they are teaching.

Participation in activities will allow the student to discover the concept for this lesson and set the foundation for the abstract thinking necessary for the abstract level. When the students then proceed to the next activity in their books, they will continue to experience this connection process. Ask participants, "Why is it so important for students to see the connection between the concrete activity and the abstract symbols?"

The Connected Mathematics Project (CMP) was funded by the National Science Foundation to develop a mathematics curriculum for grades 6, 7, and 8. The result was *Connected Mathematics*, a complete mathematics curriculum that helps students develop understanding of important concepts, skills, procedures, and ways of thinking and reasoning in number, geometry, measurement, algebra, probability, and statistics.

The key features of *Connected Mathematics* are:

- It is problem-centered.
- It provides practice.
- It is complete.
- It is for teachers as well as students.
- It is research based.
- It is effective.
- It is aligned with the NCTM *Principles and Standards 2000*.

Activity:

The goal for this presentation is to make your transition into Connected Mathematics easier. We look forward to continuing to work with you and your students as we all attempt to meet the challenges the next century will present. Together, we can create increased achievement and interest in mathematics for all of your students.

Show and Discuss Powerpoint Slide Presentation from Connected Mathematics

General 1 – CMP Title

General 2 – Development Staff

General 3 - CMP Authors

General 4 – CMP Goal 1

General 5 – CMP Goal 2

General 6 – Guiding Themes

General 7 – Units by Grade 1

General 8 - Units by Grade 2

General 9 – Math Strands

General 10 – Curriculum

General 11 – Student Materials

General 12 – Teacher Materials

General 13 – Launch Explore Summarize

General 14 – Assessment Purposes

General 15 – Assessment Dimensions

General 16 – Assessment Checklist

General 17 – Assessment Components

General 18 – CMP & NCTM Standards 1-4

General 19 – CMP & NCTM Standards 5-8

General 20 - CMP & NCTM Standards 9-13

General 21 – Expectations after 3 years

Resources:

- Overhead Projector
- Transparencies printed from http://www.math.msu.edu/cmp/
- Computer
- Handouts of Powerpoint Slides

Day 1: Video

Rationale:

School districts throughout Ohio are focusing on mathematics improvement. Significant change in mathematics can occur as teachers engage in ongoing professional discussions about the latest in research and best classroom practice, what students should know and what kind of instruction supports successful student learning.

Activity:

Show Video: "Connected Mathematics in Ohio" (17:56 minutes)

A Video for Middle Grade Math Teachers, School Administrators and Parents

Resources:

The Connected Mathematics Project for the State of Ohio is a collaborative effort of:

The Western Regional Professional Development Center

The Ohio Department of Education

Rio Grande University

Day 1: Group Management Techniques for your CMP Classroom

Rationale:

Working collaboratively allows students to tackle more complicated and more conceptually difficult problems. Carefully managed, collaborative learning can be a powerful tool for teachers to use during classroom instruction. Many of the problems in CMP are mathematically demanding, requiring students to gather data, consider ideas, look for patterns, make conjectures, and use problem-solving strategies to reach a solution. For this reason, the Teacher's Guide often suggests that students work on the exploration of a problem collaboratively. Group work supports the generation of a variety of ideas and strategies to be discussed and considered, and it enhances the perseverance of students in tackling more complicated multistep and multipart problems. It is appropriate to ask students to think about a problem individually before moving into groups, allowing them to formulate their own ideas and questions to bring to the group. These multiple perspectives often lead to interesting and diverse strategies for solving a problem.

Activity:

It is important to clearly communicate expectations about group work to students and then hold them to those expectations. Post and discuss a set of guidelines so students understand their responsibilities.

Collaborative Group Rules

1.) You are responsible for your own work and behavior.

(What does that mean to you?)

2.) You must help any group member who asks for help.

3.) You may ask a teacher for help only when everyone in your group has the same question. Only the "communicator" may ask.

4.) You must be able to present any part of the problem when your group is done.

Resources:

- Handout
- Collaborative Group Rules Poster

Day 1: Explore "The Locker Problem"

Rationale:

The Locker Problem is Investigation 6, the very last Investigation, in the 6th grade unit entitled, *Prime Time*, which is the first unit of study in the CMP series. In this Investigation, students use many of the properties they have learned about numbers to unravel a fanciful problem about a school with 1000 lockers. The Locker Problem serves as a summary of the study of factors and multiples, but the skills learned in this unit should continue to develop throughout the year as students work on other problems.

Activity:

Read the directions for the problem with participants. Help participants make sense in defining "changing states" of lockers. Review problem solving strategies students could use to solve problem. Divide participants into groups to work on the problem. If a group is having difficulty, suggest that they look at questions 1 – 4 in Problem 6.1 Follow-Up and then return to the problem.

Discuss and analyze rubric with participants.

Resources:

- Sample Rubric
- Chart Paper
- Colored Markers
- Different Colored Post-it Notes
- Transparency Pages of Open and Closed Lockers
- Grid Paper

Name: Date:

The Locker Problem (*Prime Time* Investigation 6.1)

Writing to Communicate Mathematical Thinking

_____
3 pts

I. Restate the problem in your own words.

_____
5 pts

II. Explain how you solved the problem.

*What **strategy** did you use to solve an easier problem of 12 lockers or 50 lockers?*

*What **patterns** did you find to help you solve the problem for 1000 lockers?*

_____
5 pts

III. Discuss your final answer.

Which lockers were open at the end?

Why were they open?

Hint: *Count the number of factors of each open locker.*

What do you see?

_____
2 pts

IV. Your write-up is on time, neat, and presented with this rubric.

Comments:

Day 1: "The Locker Problem" Group Presentations and Discussion

Rationale:

The classroom conversation that occurs during the summarizing phase provides an important opportunity to push students' mathematical thinking. By examining and testing ideas, students can learn mathematical skills and strategies and make connections and generalizations.

Activity:

Students should be prepared to share the group's ideas, solutions, and strategies and to explain why they think they are correct. They should make sure to look back at the original problem and check that the solutions make sense.

Encourage students to respond to another group's presentation, conjectures, strategies, or questions. Have students summarize the essence of a group's presentation. Have others in the class ask questions to challenge the group's thinking. Find opportunities for struggling students to present when you know they have correct answers. If there is repetition among strategies, have students discuss the similarities or contribute new thoughts, rather than just repeat ideas. Encourage students to look for common ideas in their strategies and representations.

Resources:

- Chart Paper
- Colored Markers
- Different Colored Post-it Notes
- Transparency Pages of Open and Closed Lockers
- Grid Paper

Day 2: Details of Teaching a CMP Lesson

- "Hot Button Issues"
- Middle School Memories
- Video - MMM
- Solve and Discuss a Problem from CMP
- Planning to Teach a CMP Unit
- Break-Out Groups by Grade Level

  (Grade 6 – *Prime Time*)

  (Grade 7 – *Covering and Surrounding*)

  (Grade 8 – *Variables and Patterns*)

- Journals in CMP

Day 2: Middle School Memories

Rationale:

Past experiences in teachers' lives as students of mathematics can greatly affect the way teachers teach. It is important for teachers, especially those who had negative experiences, to come to terms with the conditions that surrounded those feelings. The way a teacher reflects back to his or her own prior math experiences can have a significant impact on his/her students' learning. Keeping a positive outlook on mathematics learning can help promote success among students in the classroom.

Teachers should consistently and constantly reflect on their practice. It is through reflection that teachers continue to grow and to develop the kind of classroom environment that encourages all students to become independent, confident, and reflective learners. Encourage teachers to ask questions of themselves such as, "Does the classroom environment reach every student and support his or her mathematical development?"

Activity:

Have participants generate responses to the question, "What one word could you use to describe your own middle school math experience?" Share thoughts and collect the words on a transparency with three columns, positive, neutral, and negative. Have the participants place their words in the appropriate column and explain why it belongs there.

Resources:

- Overhead Projector
- Transparency with three columns
- Transparency Markers

Day 2: Video

Rationale:

Participants will develop an "eye" for standards-based mathematics classrooms through watching and discussing videotapes of classrooms. Special attention should be given to how the teacher interacts with the children to facilitate the development of their mathematical thinking.

Modeling Middle School Mathematics (MMM) is a dynamic project designed to improve mathematics instruction in the middle grades. Using video lessons and the Web, MMM features the content and structure of five NSF funded middle school comprehensive mathematics curricula. Teachers have the opportunity to visit and reflect on classes through video lessons from these exemplary programs and, via the Web, gain the support necessary to implement these mathematically significant programs.

Activity:

View Video from:

Modeling Middle School Mathematics

Dynamic Math Curricula For the Middle Grades

Teacher Support Through Video and the Web

Connected Mathematics Project

Views of actual classroom experiences that serve as a common basis for discussion:

Designing Packages – Measurement – Grade 7 – 37 min.

Students record the dimensions and determine the surface area for packages for the ABC Toy Company. They explore how surface area and volume are affected with each new shape.

Resources:

Funded by the National Science Foundation

MMM was produced by Thirteen/WNET New York and funded by the National Science Foundation

for further information contact:

Bolster Education: bolstereducation@yahoo.com

Bolster Education Inc.

9 Haig Place #705

Dunedin, FL 34698-8551

Show-Me Center: showmecenter.missouri.edu

MMM: www.mmmproject.org

Videos cost $19.95 each plus $9.00 for shipping and handling.

c 2001

Day 2: Solve and Discuss "Painted Cubes"

Rationale:

Connected Mathematics is built upon the philosophy that, "All students should be able to reason and communicate proficiently in mathematics. They should have knowledge of and skill in the use of the vocabulary, forms of representation, materials, tools, techniques, and intellectual methods of the discipline of mathematics. This knowledge should include the ability to define and solve problems with reason, insight, inventiveness, and technical proficiency" (Lappan, 2002).

As teachers become more experienced, they increasingly recognize the importance of connecting the concrete activity through the pictorial level to the symbolic recording of the concepts they are teaching. Problem Solving lessons continue to develop the students' understanding of the concept.

Participation in activities will allow the student to discover the concept for this lesson and set the foundation for the abstract thinking necessary for the abstract level. When the students then proceed to the next activity in their books, they will continue to experience this connection process.

As stated earlier, the number one area of emphasis in the NCTM Standards is that of problem solving. In Connected Mathematics, the problem-solving strand is thoroughly integrated into all of the other strands. This demonstrates relevance and application to the students. Students are provided with a framework that helps structure all problem-solving situations to help students determine what to do to solve the problem.

Students are continually presented with lessons that focus on understanding the situation, finding and analyzing data, planning the solution using appropriate strategies,

estimating the answer, solving the problem, and examining the answer for correct computation and reasonability. Each year these skills are extended.

As students learn problem solving strategies, they are given opportunities to practice choosing the best strategy to solve different problems. Problems are also included, as suggested by the NCTM Standards, in which different students may select different strategies, using those that are more comfortable for them.

As you have seen, Connected Mathematics provides your students with the tools that they will need to develop a true understanding of mathematics. They will become mathematically competent, utilize their skills in problem-solving situations, and obtain the confidence necessary to succeed in future mathematics courses and in the world in which they live.

Activity:

Introduce the Painted Cubes activity from the 8th grade unit entitled, *Frogs, Fleas, and Painted Cubes*. It is an Investigation unto itself but can also be used as a unit project. Have participants explore the problem and complete the chart and questions on the handout.

Resources:

- 2-page handout "Painted Cubes Activity"
- Snap Cubes

NAME:_____ DATE:_____

PERIOD:_____

PAINTED CUBES ACTIVITY

Your group will be investigating what happens when different sized cubes are constructed from unit cubes, the surface area is "painted" and the large cube is disassembled into its original unit cubes. You will determine how many unit cubes are "painted" on three faces, two faces, one face, and no faces.

I.) PROCEDURE

a.) Build one large cube at a time with the given dimensions (on the chart).

b.) Imagine "painting" the surface area of the large cube (including the bottom).

c.) In the chart, record the number of unit cubes that have three faces "painted", then two faces "painted", one face "painted", and zero faces "painted", as you disassemble the large cube. BE OBSERVANT! Notice the locations/patterns involved.

Cube Length	Dimensions	Cubes	3 Faces	2 Faces	1 Face	0 Faces
2	2 x 2 x 2					
3						
4						
5						
6						
7						
N						

II.) GENERALIZATIONS

a.) What generalizations can you make about the number of unit cubes that have more than three "painted" faces?

b.) What generalizations can you make about the number of unit cubes that have exactly three "painted" faces?

c.) Describe how you could predict in the future the number of unit cubes with exactly two "painted" faces.

d.) Describe how you could predict in the future the number of unit cubes with exactly one "painted" face.

e.) Describe how you could predict in the future the number of unit cubes with exactly zero "painted" faces.

Day 2: Planning to Teach a CMP Unit

Rationale:

The process of planning CMP lessons in a thoughtful way takes time. Identifying the essential mathematical ideas in the investigation and assigning appropriate homework problems requires careful planning.

Providing outstanding teacher support is a priority for Connected Mathematics. The program incorporates the very best of what is known by math teachers and what math teachers told the CMP authors during piloting.

The Teacher's Guide and program supplements are carefully designed to contain a wealth of learning activities, ideas for presenting new content, and suggestions for making mathematics accessible for all students.

The purpose of this section is for teachers to take a close look at the materials, the information they contain, the way they are organized, and most important, how to use them in planning and teaching your daily lessons. Participants should follow along with a unit from their own grade level.

You will find that no matter what level you teach, the format is consistent. The Table of Contents lists the specific lessons within each Investigation. Complete grade level objectives are listed to make curriculum planning easier. Each unit has a pacing guide. Of course, your own pace will be determined by the needs of your students and by the guidelines required by your state and local school district. A materials chart identifies in which chapters important materials are utilized. Detailed materials lists precede each Investigation.

The challenge in developing a Teacher's guide is to provide support and options for instruction and organize it into a format that is easy to use and manage. To do this, CMP uses page numbers that correlate with the students' books. On the following pages are the Teaching Notes, which go along with the lessons in the students' books.

An important strength of Connected Mathematics is the problem-solving aspect, which is embedded into each Investigation. To help you teach problem-solving, the Lesson Notes are provided to describe teaching actions that lead the students through the experience. Grouping suggestions are also given to help with organizing students. CMP gives the flexibility to structure your lessons as small groups, pairs, or individual students – whatever works well for the classroom.

DAILY LESSONS

To help structure lessons, CMP uses a three-step teaching plan: Launch, Explore, and Summarize. This lesson plan is used consistently throughout grade levels so teachers and students always know what to expect.

Launching: Engaging the Students

Role of the Teacher:
- Introduces new concepts
- Reviews old concepts
- Helps students understand the context
- Issues the mathematical challenge

Exploring the Situation

Role of the Students:
- Gather data
- Share ideas
- Look for patterns
- Make conjectures
- Develop strategies
- Create arguments to support reasoning and solution

Role of the Teacher:
- Asks questions
- Observes individual differences
- Encourages
- Redirects
- Provides extra challenges

Summarizing the Results

Role of Teacher and Students
- Collect, organize, and analyze data
- Observe differences and similarities
- Discuss strategies; refine strategies
- Develop rules or generalizations
- Verify generalizations
- Apply skills and understandings

Stop and review lesson structure with the participants.

Mathematical Reflections at the end of each Investigation provide students with different ways to reflect on their work and to discuss their generalizations. Students should be encouraged to read, write, discuss, and listen in math.

The Assignment Guide offers suggestions for individualizing assignments for all students. ACE problems provide a means for differentiating instruction in the mathematics classroom and meeting the needs of all learners. Applications problems provide more straight practice of the lesson concepts from that Investigation. Connections are thought provoking problems for challenging all learners. For those students who have mastered the skills, the Extensions will challenge and provide more critical thinking opportunities.

In the back of each Teacher's Guide you will find the Additional Practice opportunities. These problems are additional exercises that could be used for independent practice or homework. Also in the back, find the index, and the glossary.

INVESTIGATION BY INVESTIGATION

Now that we have looked at how each unit is organized, take a look at an Investigation. Each of these sections begins with an Overview and special unit opener. Discuss the value of Unit Openers with the participants.

Also included are helpful ideas for addressing diverse student needs within your classroom. Each problem captures student interest with an activity designed to introduce math concepts in a motivational setting.

PRACTICAL CLASSROOM USAGE

Now let's focus on how to use all of this information in your classroom. As the focus has shifted from repetitive drill and practice to critical thinking and problem solving, so has the instructional emphasis for teachers.

The way most of us were taught mathematics and the way many were taught to teach mathematics has changed dramatically. Manipulative materials, cooperative grouping, math reasoning, and communication are all very real aspects of today's classrooms. Teachers should spend a great deal of time moving around the classroom, talking to students individually. Teaching mathematics means getting out there and talking to the students.

Using manipulatives and promoting student interaction and communication often create a noise level that some teachers are unaccustomed to. After a while, however, teachers will be able to sense when the noise is not constructive. Teachers should develop their own special method to refocus attention if necessary.

Starting a new program creates new challenges with new content, a new format, different kinds of lessons and student behaviors. It takes time to become familiar with it all.

A question sometimes asked by teachers is, "How can I do all of this everyday?" The answer is, "You can't!" In fact, the answer might be, "Please do not try to do it all." There are a wide variety of options assembled for teachers. Having choices may be a bit overwhelming. Teachers should take a close look at the program components and options to meet individual needs.

CMP provides a variety of suggestions and strategies for every lesson, more than anyone could use at any one time. As the years pass, teachers will enjoy the flexibility of choosing activities that meet the needs of different students and classes. It is important for teachers to know that they can make choices in teaching the program. Teachers know their students best. They know their state and district guidelines. And they know what works best in their classroom. What CMP has done is provide many options for use.

Teachers who are actively implementing CMP have made suggestions based on their experiences.

1.) You don't have to do it all – not everything in each lesson, nor every lesson in the book. Some lessons can occasionally be omitted.

2.) In-depth introduction of concepts and skills with manipulatives will help build understanding.

3.) ACE problems and Additional Practice problems are very important to the maintenance of skills and they are much more interesting and appropriate than excessive drill.

4.) Use of language is integrated throughout the program.

5.) Many of the things in Connected Mathematics are things that we are already doing.

Activity:

Conduct a summary discussion and answer participant's questions. Use these questions to encourage thought and discourse. Remind the participants that change takes time and that they are not expected to do everything during the first year.

- How might the Connected Mathematics Teacher's Guide help you enhance your teaching of Mathematics?
- Ask participants to describe the components of the program that look the most exciting.

Discuss Lesson Planning to meet district and administrative goals.

- Set up a three-ring binder for each unit of CMP.
- Photocopy the "Teaching the Investigation" section found after each Investigation in the Teacher's Guide. This is the lesson "script." Use this to help you fill out the Lesson Preparation Sheet for each Problem.

One Problem can be covered each day (roughly).

Discuss Homework in CMP

- General homework problems can be Follow-up or ACE questions.
- At the end of each Investigation there is the ACE section, which includes extra problems that are Applications, Connections, or Extensions to the Problems explored in class.
- In class, allow the students to work together to figure out the answers and jot down notes about the answers. Then for homework, students should write the answers in complete sentences and provide evidence for their thinking.
- Go over the answers during the following class session and tell students to make corrections. Now they should have no answers that are mathematically incorrect in their notebooks.

Break the Telling Habit! Try to NEVER ANSWER a STUDENT'S QUESTION! (Mean, huh!) Instead, try to redirect the question back to him or her. Have students read the question again, ask them for some reply, and then determine how much guidance they need in order to lead them in the right direction.

Resources:

- 3-ring binder
- Hole puncher
- Handout "Lesson Plan Outline"
- Handout "The Teacher Notebook"

Lesson Plan Outline

Book Title:

Strand:

Investigation #:

Problem #:

Procedure:

1.)

2.)

3.)

4.)

5.)

Objective:

Procedure:

Launch:

Explore:

Summarize:

Evaluation:

Standards:

Lesson Summary:

Transparencies:

Handouts:

Manipulatives:

Other Materials:

Homework:

Notes:

The Teacher Notebook

A well-organized and current notebook should be kept with the following contents:

1.) Lesson Plans – past and current, including reflections, teacher made materials, any supplemental work (GEPA Warm-ups, additional assessment, etc.) Suggestion: keep both a hard copy and a disk copy)

2.) Your solutions to the problems. You should be at least one full Investigation ahead. For example, if you are in 2.2, you should have done all of Investigations 2 and 3. Remember that you are trying to build conceptual understanding, so using shortcuts and algorithms, or showing a simple numerical answer is not sufficient preparation for facilitating the exploration. Think about a variety of ways to approach and solve the problems.
3.) Summaries – for all Investigations you're in and all of the next Investigation solutions, to parallel the solutions.

The Teacher's Guides and Lesson Planner provide much of the planning. For this reason the pacing charts and objectives have been put on disk for you in the new lesson plan format. You can make the space to write in as large as you want. Then print the plans out.

You can make notes about how you will launch the lesson, what you will look for or concentrate on during the exploration, grouping strategies, etc.

Investigations should be done in order and the dates should be recorded. You should also keep track of the GEPA problems used and any procedural or content mini-lessons that you do.

Reflections on the lesson: What worked well? What didn't work so well? Were there adjustments you made to make the Investigation work?

Teacher Notes (for the next time this Unit is taught.)
Reflections: Write anything here that would be helpful to you or anyone who uses this unit in the future. Were there adjustments you made to the Unit or to an investigation that made it work better?

Day 2: Break-Out Groups

Rationale:

CMP changes the work and expectations of both teachers and students. The curriculum includes areas of mathematics that may be new to teachers, and investigates familiar material in greater depth than do more traditional texts. The program is problem centered, so teachers must also understand how the concepts, skills, procedures, and processes are developed. Teachers will need help and support in acquiring the knowledge needed to teach these materials.

In addition, teachers may be unsure of the questions, ideas, and conjectures students bring up. They must learn to make on-the-spot decisions about when to explore a topic more in depth and when to redirect the class. Teachers' roles are shifting from an emphasis on delivering information to one of orchestrating inquiry lessons. Teachers will need help in understanding and implementing the instructional model built into CMP.

Activity:

Teachers need time to explore the rich problem-solving situations in CMP and to develop understandings in a variety of ways. Participants should take time to explore the Investigations from the units they will implement during the first year. As recommended by CMP on page 51 of Getting to Know Connected Mathematics: An Implementation Guide, the first unit at each grade level is as follows:

- Grade 6 – *Prime Time* (6th grade unit)
- Grade 7 – *Covering and Surrounding* (6th grade unit)
- Grade 8 – *Variables and Patterns* (7th grade unit)

Since each unit builds on several preceding units, it is not always easy to start with seventh grade units in grade seven and eighth grade units in grade eight during the first year of implementation. It is often better to teach some key units from the previous year that are prerequisites for the grade level units.

Resources:

- Student texts and Teacher's Guide for *Prime Time*
- Student texts and Teacher's Guide for *Covering and Surrounding*
- Student texts and Teacher's Guide for *Variables and Patterns*

Day 2: Journals in CMP

Rationale:

Journal Writing can:

- Help organize the thought process.
- Focus on particular aspects of conceptual understanding.
- Clarify thinking.

Student Benefits:

- Better retention of information.
- Promotes increased understanding of mathematics.
- Stimulates/fosters thinking about mathematics.
- Improves writing ability.
- Provides opportunities to express feelings regarding mathematical learning.

Teacher Benefits:

- Helps determine students' progress of conceptual and procedural knowledge regarding important mathematical ideas.
- Helps teachers to redirect their re-teaching of particular concepts and to "go back and reiterate things" that may not have been made clear previously.
- Assists teacher in formulating questions that will help to probe student thinking and enhance student understanding.
- Is an alternate from of assessment (informal or formal).
- Helps to gain insight to students' attitudes and feelings about mathematics.

Mathematical Journal Writing is a process of written communication that must be slowly nurtured.

- It is recommended that you do not grade or correct work in student journals. Instead, write a comment or question that students can consider and think about as they continue to work on a particular investigation.
- Encourage the use of drawings and/or pictures to aid explanations and communication of mathematical thinking.

Activity:

Opportunities to explain, conjecture, and defend one's ideas in writing can stimulate deeper understandings of concepts and principles. Assign homework to participants as if they were students. Write a journal entry from a problem discussed during the break-out group session. Use the "DS 50" guidelines to help if necessary.

Resources:

- Handout: DS 50

What is a DS 50?

A DS 50 is a daily summary/journal reflection of the investigation and assignment completed in math class. It must be a minimum of fifty words. Try to incorporate the use of general math terms and the *essential vocabulary* terms in your summary.

Use the following list to guide you in your writing:

- Explain/describe how you and your group solved the problem.
- Discuss why you feel the solution you came up with is reasonable.
- List at least one thing you learned today.
- Did you like solving this problem? Why or why not?
- Was it difficult or easy? Why?
- If you did not understand any part of the problem, please write a sentence describing what you are confused about or if you have a specific question, write it down so I can help you.
- Describe how your group worked together. Did your partners take turns, share ideas, help each other, and listen to each other respectfully?

Use the following prompts to help you write your DS 50.

- Today in class, my group worked on Problem…
- One thing I learned was…
- My group started by…
- Then we decided to… because we knew that…
- We felt that the solution we came up with was reasonable because…

Day 3: Assessment and Student Work

- "Hot Button Issues"
- Examine Student Work using Rubrics
- Assessment in CMP
- Break-Out Groups by Grade Level

  (Grade 6 – *Data About Us*)

  (Grade 7 – *Bits and Pieces II*)

  (Grade 8 – *Comparing and Scaling*)

Day 3: The Orange Juice Problem

Rationale:

In the following problem from *Comparing and Scaling*, students are developing proportional-reasoning skills. As they solve Problem 3.1, they build on their prior knowledge of fractions and rational numbers.

CMP emphasizes multiple forms of representation. Students learn to reason, to communicate, and to solve problems using tables and graphs and pictures as well as symbolic expressions and equations. The groups' work shows that students have the flexibility in using fractions, decimals, and percents to make their comparisons of ratios.

Activity:

Ask participants to examine samples of student work in groups and to assign a numerical score from the simple rubric provided. Then have participant groups share their thoughts.

- 3 There
- 2 Almost There
- 1 Barely There
- 0 Where Are You

Resources:

- Samples of student work can be found on the CMP website www.math.msu.edu/cmp

Day 3: Assessment in CMP

Rationale:

Connected Mathematics includes assessments that emphasize concept understanding and communication. Assessments involve activities that directly reflect what was done in the lessons. Students show what they have learned by writing what they know. This can be done individually, in pairs, or in small groups. They offer an effective way to incorporate alternative assessments into the classroom on a daily basis.

Activity:

Analyze various forms of assessments included in CMP from various Teacher's Guides and *Getting To Know Connected Mathematics* (pages 19 – 23 and 34 – 40).

- Copy some of the ACE questions and just change the key numbers in the problem.
- Have students take out their ACE problems from their homework and copy exactly what they have written for five questions of your choice.
- The Mathematical Reflections at the end of each section are great too! You can use these questions in the same manner with the same ideas as the first two options above.
- All assessments should be three hole punched and stored in the student's notebook for easy reference for both students and parents.

Resources:

- Teacher's Guides from various CMP Units
- *Getting To Know Connected Mathematics* (pages 19 – 23 and 34 – 40)

Day 3: Break-Out Groups

Rationale:

CMP changes the work and expectations of both teachers and students. The curriculum includes areas of mathematics that may be new to teachers, and investigates familiar material in greater depth than do more traditional texts. The program is problem centered, so teachers must also understand how the concepts, skills, procedures, and processes are developed. Teachers will need help and support in acquiring the knowledge needed to teach these materials.

In addition, teachers may be unsure of the questions, ideas, and conjectures students bring up. They must learn to make on-the-spot decisions about when to explore a topic more in depth and when to redirect the class. Teachers' roles are shifting from an emphasis on delivering information to one of orchestrating inquiry lessons. Teachers will need help in understanding and implementing the instructional model built into CMP.

Activity:

Teachers need time to explore the rich problem-solving situations in CMP and to develop understandings in a variety of ways. Participants should take time to explore the Investigations from the units they will implement during the first year. As recommended by CMP on page 51 of Getting to Know Connected Mathematics: An Implementation Guide, the first unit at each grade level is as follows:

- Grade 6 – *Data About Us* (6th grade unit)
- Grade 7 – *Bits and Pieces II* (6th grade unit)
- Grade 8 – *Comparing and Scaling* (7th grade unit)

Since each unit builds on several preceding units, it is not always easy to start with seventh grade units in grade seven and eighth grade units in grade eight during the first year of implementation. It is often better to teach some key units from the previous year that are prerequisites for the grade level units.

Resources:

- Student texts and Teacher's Guide for *Data About Us*
- Student texts and Teacher's Guide for *Bits and Pieces II*
- Student texts and Teacher's Guide for *Comparing and Scaling*

Day 4: Management Techniques

- "Hot Button Issues"
- Management Techniques for Notebooks and Materials
- Video "MMM CMP classroom"
- Break-Out Groups by Grade Level

  (Grade 6 – *Shapes and Designs*)

  (Grade 7 – *Variables and Patterns*)

  (Grade 8 – *Moving Straight Ahead*)

Day 4: Management Techniques for Notebooks and Materials

Rationale:

These issues seem to be the majority of the "Hot Button Issues." Experienced CMP teachers have shared ideas they have used to help manage student notebooks and grading.

Activity:

Have participants read pages 32 – 34 in the Getting To Know Connected Mathematics book for different suggested ideas of what would work best in their classroom setting. Brainstorm about different ways students could design their own notebook structure like including separated sections or chronological order. Also offer sample student notebooks as a guide if possible.

Set up a model materials table and discuss it's contents, purpose and management issues.

Resources:

- 3-Ring Binder
- Getting to Know Connected Mathematics
- Sample Student Notebooks
- Materials Table

Day 4: Video

Rationale:

Participants will develop an "eye" for standards-based mathematics classrooms through watching and discussing videotapes of classrooms. Special attention should be given to how the teacher interacts with the children to facilitate the development of their mathematical thinking.

MMM is a dynamic project designed to improve mathematics instruction in the middle grades. Using video lessons and the Web, MMM features the content and structure of five NSF funded middle school comprehensive mathematics curricula. Teachers have the opportunity to visit and reflect on classes through video lessons from these exemplary programs and, via the Web, gain the support necessary to implement these mathematically significant programs.

Activity:

View Video from:

Modeling Middle School Mathematics

Dynamic Math Curricula For the Middle Grades

Teacher Support Through Video and the Web

Connected Mathematics Project

Views of actual classroom experiences that serve as a common basis for discussion.

Looking for Squares – Number – Grade 8 – 34 min.

Students find as many squares as possible that will fit in a five by five grid, and the class determines the relationship between side and area. This leads to investigation of square roots using estimation.

Resources:

Funded by the National Science Foundation

MMM was produced by Thirteen/WNET New York and funded by the National Science Foundation

for further information contact:

Bolster Education: bolstereducation@yahoo.com

Bolster Education Inc.

9 Haig Place #705

Dunedin, FL 34698-8551

Show-Me Center: showmecenter.missouri.edu

MMM: www.mmmproject.org

Videos cost $19.95 each plus $9.00 for shipping and handling.

c 2001

may wish to have participants do problem/investigation and then watch

Day 4: Break-Out Groups

Rationale:

CMP changes the work and expectations of both teachers and students. The curriculum includes areas of mathematics that may be new to teachers, and investigates familiar material in greater depth than do more traditional texts. The program is problem centered, so teachers must also understand how the concepts, skills, procedures, and processes are developed. Teachers will need help and support in acquiring the knowledge needed to teach these materials.

In addition, teachers may be unsure of the questions, ideas, and conjectures students bring up. They must learn to make on-the-spot decisions about when to explore a topic more in depth and when to redirect the class. Teachers' roles are shifting from an emphasis on delivering information to one of orchestrating inquiry lessons. Teachers will need help in understanding and implementing the instructional model built into CMP.

Activity:

Teachers need time to explore the rich problem-solving situations in CMP and to develop understandings in a variety of ways. Participants should take time to explore the Investigations from the units they will implement during the first year. As recommended by CMP on page 51 of Getting to Know Connected Mathematics: An Implementation Guide, the first unit at each grade level is as follows:

- Grade 6 – *Shapes and Designs* (6^{th} grade unit)
- Grade 7 – *Variables and Patterns* (7^{th} grade unit)
- Grade 8 – *Moving Straight Ahead* (7^{th} grade unit)

Since each unit builds on several preceding units, it is not always easy to start with seventh grade units in grade seven and eighth grade units in grade eight during the first year of implementation. It is often better to teach some key units from the previous year that are prerequisites for the grade level units.

Resources:

- Student texts and Teacher's Guide for *Shapes and Designs*
- Student texts and Teacher's Guide for *Variables and Patterns*
- Student texts and Teacher's Guide for *Moving Straight Ahead*

Day 5: Questioning

- "Hot Button Issues"
- Explore "The Peg Game"
- The Role of Questioning in the CMP Classroom
- Break-Out Groups by Grade Level

  (Grade 6 – *Bits and Pieces I*)

  (Grade 7 – *Stretching and Shrinking*)

  (Grade 8 – *Looking for Pythagoras*)
- Supplies and Support
- Closure

Day 5: "The Peg Game"

Rationale:

This puzzle is offered as an extension problem after Investigation 4 in the 8th grade unit, *Frogs, Fleas, and Painted Cubes*. This activity provides participants with an example of how an ACE problem can be redesigned to meet the needs of the classroom. It also continues to model the types of problems embedded in CMP with "multiple entry points" in order to differentiate learning.

Activity:

Read and review the directions for the game together.

The object of this game is to exchange the colored chips from each side to the opposite one. You will use the game boards printed for you on the handout. Each row of circles is a game board, so there are five game boards on each worksheet. You may use any board that seems right for you. The rules for moving chips are the following:

1.) You may move a colored chip only in the direction away from the side where it started. The arrows on top are there to remind you of the direction that each piece moves.

2.) You may move only to the next free space (slide), or over a single playing piece to a free space (jump).

Keep track of the number of moves it takes to exchange the colored chips. It might make sense to begin with one chip of each color (the board with three spaces), and then try the second board (with five spaces), and so on, until you have found a rule or pattern for how many moves it takes to exchange the pieces, no matter what may be the size of the game board.

Find as many patterns as you can while you play the game!

Resources:

- Directions posted for participants
- Circular Chips of Two Different Colors
- Game Boards
- Chart Paper
- Colored Markers
- Grid Paper

Day 5: The Role of Questioning in the CMP Classroom

Rationale:

Why does it matter if and how a teacher asks questions? Questions can shape student learning. Asking the right question is an art to be cultivated both by educators and by students, for teaching and learning as well as for assessment. Questions and responses may be oral, written, or demonstrated by actions. Good questions and their responses will contribute to a climate of thoughtful reflectiveness. Review these sample questions in these eleven categories.

Problem Comprehension Questions

Can students understand, define, formulate, or explain the problem or task? Can they cope with poorly defined problems?

- What is the problem about?
- What can you tell me about it?
- What is the question asking you to do?
- Would you please explain that in your own words?
- What do you know about this part?
- Do you need to define or set limits for the problem?
- Is there something that can be eliminated or that is missing?
- What assumptions do you have to make?

Approach and Strategy Questions

Do students have an organized approach to the problem or task? How do they record? Do they use tools such as manipulatives, diagrams, graphs, calculators, or computers appropriately?

- How are you going to find the answer?
- Where could you find the needed information?
- What have you tried?
- What steps did you take?
- What did not work?
- How did you organize the information?
- Do you have a record?
- Did you have a system? A strategy? A design?
- Have you tried tables? trees? lists? diagrams?
- Would it be helpful to draw a diagram or make a sketch?
- How would it look if you used these materials?
- How would you research that?

Relationship Questions

Do students see relationships and recognize the central idea? Do they relate the problem to similar problems previously done?

- What is the relationship of this to that?
- What is the same?
- What is different?
- Is there a pattern?
- Let's see if we can break it down. What would the parts be?
- What if you moved this part?
- Can you write another problem related to this one?

Flexibility Questions

Can students vary the approach if one approach is not working? Do they persist? Do they try something else?

- Have you tried making a guess?
- Would another recording method work as well or better?
- What else have you tried?
- Give me another related problem. Is there an easier problem?
- Is there another way to (draw, explain, say...) that?

Communication Questions

Can students describe or depict the strategies they are using? Do they articulate their thought processes? Can they display or demonstrate the problem situation?

- Would you please reword that in simpler terms?
- How would you explain what you know right now?
- How would you explain this process to a younger child?
- Could you write an explanation for next year's students (or some other audience) of how to do this?
- Which words were most important? Why?

Curiosity and Hypothesis Questions

Do students show evidence of conjecturing, thinking ahead, checking back?

- What do you predict will happen?
- What was your estimate or prediction?
- How do you feel about your answer?
- What do you think comes next?
- What else would you like to know?

Self-Assessment Focused Questions

Do students evaluate their own processing, actions, and progress?

- What do you need to do next?
- What are your strengths and weaknesses?
- What have you accomplished?
- Was your own group participation appropriate and helpful?

Equality and Equity Focused Questions

Do all students participate to the same degree? Is the quality of participation opportunities the same?

- Do you work together? In what way?
- Have you discussed this with your group? With others?
- Where would you go for help?
- How could you help another student without telling the answer?
- Did everybody get a fair chance to talk, to use the manipulatives, or to be recorder?

Solutions Questions

Do students reach a result? Do they consider other possibilities?

- Is that the only possible answer?
- How would you check the steps you have taken, or your answer?
- Other than retracing your steps, how can you determine if your answers are appropriate?
- Is there anything you have overlooked?
- Is the solution reasonable, considering the context?
- How did you know you were finished?

Examining Results Questions

Can students generalize, prove their answers? Do they connect the ideas to other similar problems or to the real world?

- What made you think that was what you should do?
- Is there a real-life situation where this could be used?
- Where else would this strategy be useful?
- What other problem does this seem to lead to?
- Is there a general rule?
- How were you sure your answer was right?
- How would your method work for other problems?
- What questions does this raise for you?

Mathematical Learning Questions

Did students use or learn some mathematics from the activity? Are there indications of a comprehensive curriculum?

- What were the mathematical ideas in this problem?
- What was one thing you learned (or two, or more)?
- What are the variables in this problem? What stays constant?
- How many kinds of mathematics were used in this investigation?
- What is different about the mathematics in these two situations?
- Where would this problem fit on our mathematics chart?

Activity:

TYPES OF QUESTIONS YOU ASK

What Categories of Questions Did You Ask Your Students Today In Math?

Please write the actual questions that you asked, might ask, or could ask during an investigation. You can either reflect on a real investigation you already did with your students or consider the new investigation you are planning to teach. You may also analyze another teacher's lesson live in the classroom or view a video of the classroom lesson.

A Problem Comprehension Question

An Approach or Strategy Question

A Relationship Question

A Question About Flexibility

A Communication Question

Curiosity and Hypothesis

A Self-Assessment Focused Question

A Focused Question on Equality and Equity

A Question About Solutions

A Question About Examining Results

A Mathematical Learning Question

Offer suggestions for facilitating activities while students are in the "exploring" stage.

Monitoring

While the students are working, watch to see how easily they are solving the problem and how well they are working together. Occasionally, ask a student to explain one of the findings already agreed on and recorded to emphasize the fact that all group members need to be able to explain the answers. Often, turn students' questions back to the group to solve, or ask students to check with a neighboring group.

Intervening

When a group is obviously struggling, watch for a moment, then intervene. Point out the problem and ask the group what can be done about it. This establishes the teacher's role as one of consultant rather than answer giver. "What is the group going to do about this?" is a useful phrase for you in the cooperative goal structure. You can (and should) suggest possibilities along with the students, sometimes explain a skill, and help the group decide on an effective strategy. Then refocus the group on the task and move on.

Resources:

Processes Involved in Thinking Mathematically
(or Habits of the Mind)

1. posing problems and questions
2. exploring a question systematically
3. generating examples
4. specializing
5. generalizing
6. devising symbols and notations
7. making observations
8. recording observations
9. identifying patterns, relationships, and attributes
10. formulating conjectures (inductively and deductively)
11. testing conjectures
12. justifying conjectures
13. communicating with an audience
14. writing to explore one's thoughts
15. writing to inform an audience
16. using appropriate techniques to solve a problem
17. using technical language meaningfully
18. devising methods or ways of solving problems
19. struggling to be clear
20. revising one's views
21. making connections between equivalent statements, expressions, or transformations
22. making comparisons
23. being skeptical, searching for counterexamples
24. reflecting on experiences
25. suspending judgment
26. sleeping on a problem
27. temporarily suspending work on a problem and returning to it later
28. listening actively to peers

Day 5: Break-Out Groups

Rationale:

CMP changes the work and expectations of both teachers and students. The curriculum includes areas of mathematics that may be new to teachers, and investigates familiar material in greater depth than do more traditional texts. The program is problem centered, so teachers must also understand how the concepts, skills, procedures, and processes are developed. Teachers will need help and support in acquiring the knowledge needed to teach these materials.

In addition, teachers may be unsure of the questions, ideas, and conjectures students bring up. They must learn to make on-the-spot decisions about when to explore a topic more in depth and when to redirect the class. Teachers' roles are shifting from an emphasis on delivering information to one of orchestrating inquiry lessons. Teachers will need help in understanding and implementing the instructional model built into CMP.

Activity:

Teachers need time to explore the rich problem-solving situations in CMP and to develop understandings in a variety of ways. Participants should take time to explore the Investigations from the units they will implement during the first year. As recommended by CMP on page 51 of Getting to Know Connected Mathematics: An Implementation Guide, the first unit at each grade level is as follows:

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- Grade 8 – *Looking For Pythagoras* (8^{th} grade unit)

Since each unit builds on several preceding units, it is not always easy to start with seventh grade units in grade seven and eighth grade units in grade eight during the first year of implementation. It is often better to teach some key units from the previous year that are prerequisites for the grade level units.

Resources:

- Student texts and Teacher's Guide for *Bits and Pieces I*
- Student texts and Teacher's Guide for *Stretching and Shrinking*
- Student texts and Teacher's Guide for *Looking For Pythagoras*

Day 5: Supplies and Support

Rationale:

Computer Test Bank
for Assessment and Additional Practice

Test Software with Question Editor for Windows and Macintosh Computers

Flexible – Built-in capability to edit, add, or delete questions

Easy To Use – Preview and print Assessment and Additional Practice resources

The TestWorks software provides electronic versions of all Assessment Resources and Additional Practice items found in the Teacher's Guides. Use the software to customize these resources to meet your classroom needs. The guide is designed for use with all three grade levels of Connected Mathematics.

Activity:

Overview

The CD-ROM contains a testbank of editable Assessment and Additional Practice questions for all three grades of the Connected Mathematics Project. Although these questions match the ones in the Teacher's Guides, these electronic versions allow the teacher to easily customize assessment and practice resources to meet the needs of their classes.

With the TestWorks software, a teacher can:

- Quickly view and print any set of Assessment or Additional Practice questions.
- Edit, add, or delete questions.
- Combine questions from any part of the Connected Mathematics testbank.
- Create various types of graphs using the graphing tool.
- Use symbols palettes to insert symbols, fractions, and tables.

The booklet provides information about the features which a teacher will use most frequently. For a complete description of the TestWorks software, refer to the TestWorks Program Guide, which is conveniently located on the CD-ROM and can easily be printed for reference. Onscreen help is also available.

Resources:

Contents

Day 5: Closure

Rationale:

Every situation in life takes some adjustment. Adjustment may involve the ability to either "go with the flow" or take on the attitude of, "if at first you don't succeed try, try again."

At any rate, adjustment requires versatility. Versatile is defined by *Webster's Dictionary* as, "being capable of moving into a situation easily; moving freely; able to change frequently to adjust successfully, capable of doing many things competently and having various uses or functions."

In order to function as successful leaders, we must be versatile. Creating a plan, operating by an agenda, visualizing a project, preparing for students, and establishing steps to accomplish a goal are elements in being versatile. The ability to work with all types of individuals, to share the success and to assume the blame or responsibility is equally as important in being versatile.

Staying versatile requires that we, as workshop facilitators, plan well, organize, analyze programs, make agendas for meetings and events and communicate with teachers. Because we have built a strong base and developed a plan, we will be capable of moving into any situation easily.

Fear of change, resistance to growth or the shock of trauma can make us want to stop time and stand still. But as teachers, we cannot stand still. We have to adjust frequently to be successful. If we are not growing, we are disintegrating. If we are not moving forward, we are falling backwards. If we have a mission statement of what we

want to accomplish, the direction will give us the capability of doing many things competently.

Excellent leaders are those who are committed to the mission, committed to working cooperatively with all teachers and who have a vision of what they want to achieve. They strive to strengthen the department first, not to improve their own status or position.

With this in mind, it is hard not to believe that each of us as leaders must be versatile in order to complete the tasks expected of us. But it is easy to lead in an organization where the mission is so important.

So who are the best candidates for leadership? We are! Let's build on our role as workshop facilitator to develop our versatility. Let's be a free-moving, versatile member of the team, dedicated to developing and putting to work all the leadership skills we can for the good of our learners.

Activity:

Read the closing to participants.

In Closing

Mathematics is everywhere and its use will only increase in the future. To ensure that the mathematics taught in school are relevant to the needs of our students, mathematics curriculums across the country are changing. Increasingly, the purpose of mathematics instruction is to help students apply math to solve real-life problems and understand their world. More than ever students in math classes are actively involved in investigating meaningful problems, working in groups and sharing ideas and insights, examining models, using calculators and computers in problem-solving, writing about their observations and conclusions, and connecting math with other subject areas.

As a mathematics teacher, you work side-by-side with your students, encouraging and supporting their efforts in mastering math, and helping them acquire the skills that will serve them well in years to come.

Best wishes to you as you teach the crucial skills of mathematics that will prepare your students for their future success.

Resources for Participants

- Project 2061 Quality Ratings Chart of Textbook Series
- "At A Glance" Lesson Plan Outline
- Exploring the Features of the Teacher Editions
- Assessment Resources
- Parent Brochure
- Parent Handout for Back to School Night
- Teaching Notes Unit by Unit

Exploring the Features of the Teacher Editions

- Table of Contents* and Overview
- Mathematical Content*
- Mathematical and Problem Solving Goals
- Connections
- Investigations
- Materials
- Technology
- Pacing Chart
- Vocabulary
- Assessment

For each Investigation

- Launch, Explore, Summarize
- Margin Notes, answers
- A*C*E questions*

Assessment Resources

- Informal/Embedded
- Checkups
- Partner Quizzes
- Mathematical Reflections*
- Unit Test
- Unit Project* (not in all units)
- Self Assessment

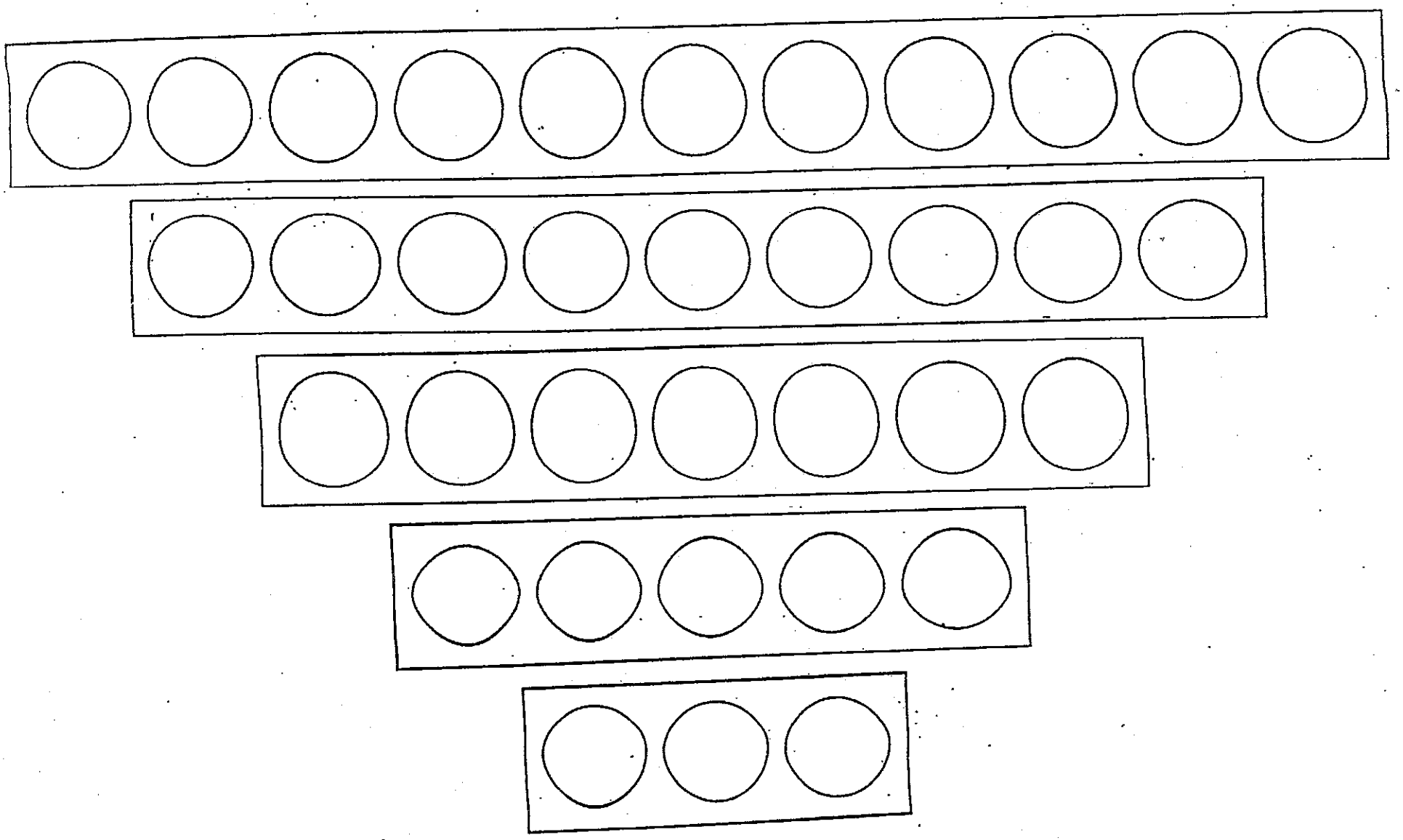
Additional Resources

- Question Bank
- Lab Sheets
- Transparency Masters
- Glossary

* items are also in student books

The Peg Game - with pennies and washers

Pennies go this way → ← Washers go this way



Will Your Child Be Ready For High School And College Mathematics?

Today's standards-based mathematics programs are designed to help your child learn the mathematics needed in high school, in college and in the workplace. High school and college teachers of mathematics want students who can think, reason and apply mathematics. Employers want workers who are willing and able to solve problems, work with their fellow employees, and communicate their thinking. Young people need to prepare for an ever-changing workplace and technological society. Flexible problem solving, working collaboratively are among skills that will help them thrive.

Standards-based mathematics curriculum materials have been designed to help address the needs of both continuing study of mathematics and preparation for the workplace.

What Kind Of Results Should You Expect?

Results indicate that students are benefiting from the balanced approach described here. Students in classrooms that utilize standards-based curriculum materials and instructional techniques do well on traditional achievement tests. And new tests using open-ended response formats show strong gains in conceptual understanding as well as procedural skills .

For More Information

Show-Me Project

The Show-Me Project provides information and resources to support the selection and implementation of the following standards-based middle grades mathematics curricula:

Connected Mathematics Project, Prentice-Hall
Math Scape, Creative Publications
MATH Thematics, McDougal Littell
Mathematics in Context, Encyclopaedia Brittanica
Pathways to Algebra & Geometry, Voyager Expanded Learning

To learn more about these curricula, or to download a copy of this brochure for unlimited duplication, see: http://showmecenter.missouri.edu

The U.S. Department of Education

An excellent source of national information with searchable topics database.

http://www.ed.gov/
Phone: 1-800-USA-LEARN

National Council of Teachers of Mathematics (NCTM)

The primary professional organization for teachers of mathematics in grades K-12, NCTM provides broad national information in matters related to mathematics education.

http://www.nctm.org/
Phone: (703) 620-9840

Figure This!

A parent-oriented website with regularly updated problems and challenges to do with your children.

http://www.figurethis.org

Mathematics Education & Your Child:

What Parents Should Know

SHOW-ME CENTER
Supporting Standards-Based Middle Grades Mathematics Curricula

Helping Your Child Learn Math

"The first teachers are the parents, both by example and conversation."
-Lamar Alexander

Helping Your Children With Homework

In helping children learn, one goal is to assist children in figuring out as much as they can for themselves (e.g., constructing meaning). You can help by asking questions that guide, without telling what to do.

Good questions and good listening will help children make sense of mathematics, build self-confidence, and encourage mathematical thinking and communication. A good question opens up a problem and supports different ways of thinking about it. Here are some questions you might try; notice that none of them can be answered with a simple "yes" or "no."

Getting Started

- What do you need to find out?
- What do you need to know?
- How can you get the information?
- Where can you begin?
- What terms do you understand or not understand?
- Have you worked similar problems that would help?

While Working

- How can you organize the information?
- Can you make a drawing (model) to explain your thinking?
- Are there other possibilities?
- What would happen if...?
- Can you describe an approach (strategy) you can use to solve this?
- What do you need to do next?
- Do you see any patterns or relationships that will help to solve this?
- How does this relate to...?
- Can you make a prediction?
- What did you...?
- What assumptions are you making?

Reflecting About The Solution

- How do you know you solution (conclusion) is reasonable?
- How did you arrive at you answer?
- How can you convince me you answer makes sense?
- What did you try that did not work?
- Has the question been answered?
- Can the explanation be made clearer?

Responding (helping your children clarify and extend their thinking)

- Tell me more.
- Can you explain it in a different way?
- Is there another possibility or strategy that would work?
- Help me understand this part...

Helping Your Children Get Organized

1.) Provide a study place. If possible, have the following materials readily available:

- Calculator (graphing calculator for 7^{th} and 8^{th} grade)
- Graph paper and notebook paper
- Ruler with both metric and standard units
- Dictionary

2.) Many children need assistance in organizing and maintaining a notebook. Help them develop a system for organizing and maintaining a notebook and notes.

3.) Help your children develop a system for writing down assignments, as well as keeping track of progress. Some schools provide student planners or assignment sheets, but that does not mean children use them consistently. Check to make sure that they are being used consistently and appropriately.

4.) Help your children develop a system for taking meaningful notes. Frequently, note taking is taught during class, so it may just be a matter of seeing if you children are taking and using notes.

5.) Encourage your children to identify study buddies or another math student they can call to work with on assignments, get clarification, find out about makeup work, etc. Some parents have established study teams and times so that students have planned opportunities to study together after school.

6.) Encourage and expect children to get work done on time, to stay caught up, to get help in a timely manner, and to correct errors in work. You may want to help children go over incorrect or incomplete work and talk about how the work could be improved.

7.) It is generally expected that middle school students know the basic addition, subtraction, multiplication and division facts as well as whole number computation. If your children are not proficient with these skills, help them master the needed skills.

Helping Your Children Develop Positive Attitudes About Math

Most parents enjoyed reading to their young children. It set an example, established a positive attitude toward reading, and developed a value that reading is both fun and important. Similarly, the parent's attitude and approach to math at home impact the importance and value that students place on learning mathematics in school.

We have tried to provide some practical suggestions to help parents help their children learn mathematics. While the information is not comprehensive, we hope it gives you some additional tools with which to help your children.

How do YOU feel about math?

Your feelings about mathematics will have an impact on how your children perceive and value mathematics, as well as how they view themselves as mathematicians. Take a moment to think about these questions:

- Did you like math in school?
- Do you think that everyone can learn math?
- Do you believe girls are as good at math as boys?
- Is it just as important for girls to learn math as boys?
- Do you think of math as important and useful in everyday life?
- Do you believe that most jobs today require math skills?
- How are your attitudes about math impacting your children's attitudes?

Two important goals for all students are that ***1.) they learn to value mathematics*** and ***2.) they become confident in their ability to do mathematics***. Parents can help children develop a "can do" disposition toward math by nurturing their children's natural curiosity and providing support and encouragement.

Doing Math At Home

1.) Math is everywhere, yet many children don't see it. Look for ways to point out and reinforce math skills at home. For example:

- Talk about how you use math at work or in the home.
- Involve children in takes that require computing, measuring, estimating, building, following directions, problem solving and reasoning.
- Look for activities that require children to use their math skills such as building scale models, cooking, planning trips, and playing logic games.

2.) Look for games and activities that teach and/or reinforce math and thinking. For example, look for games that:

- Require and develop skill with mental computation and estimation
- Require players to use their math skills
- Involve the development of strategies
- Require players to think about the probability of certain events occurring
- Require the use of spatial visualization skills
- Require logical thinking

3.) When you see articles that have data that might interest your children (e.g., sports statistics, data on teenage smoking, facts about natural disasters), share them and talk about what the numbers mean.

4.) Share your problem-solving strategies and techniques, mental computation strategies, and estimation strategies. Have your children teach you some. Work on the same problem, then compare strategies as well as answers.

5.) Invite your children to explain what was learned in math class or have them teach it to you. It provides an opportunity for children to help clarify their thinking, to practice new skills, and to practice communicating mathematically.

6.) If your children have access to a computer, look for software that reinforces and teaches math concepts. Help your children learn to use math utilities such as spreadsheets and graphing programs.

http://www.math.msu.edu/cmp/

The above ideas were taken from the Administrative Notebook for Middle School Mathematics, Plano Independent School District, Plano, Texas.

Connected Mathematics Project (CMP) Teaching Notes

The information included in the teaching notes are hints from teachers who have taught the units, and is not found in the Teacher's Guides. The notes are not intended to replace reading the Teacher's Guides.

The CMP teaching notes include tips about teaching each CMP investigation from teachers who have taught the unit. Suggestions are included to help prepare teachers for full implementation of the curriculum. Hopefully, implementing these suggestions throughout the year in the course of teaching each unit will help increase student achievement and understanding.

Also included in this resource are some additional notes, handouts, review and assessments for classroom use with students. These are available for copying and distributing to students for assistance in completing the units of study.

This document should be distributed to each math teacher and should be available in your building's math resource binder.

CONTENTS

6th Grade Units

Prime Time
Teaching Notes

Reflections

Before beginning the first problem in any of the investigations, read with students the "Mathematical Reflections" at the end of each investigation. This helps students get a sense of what the investigation focuses on. It is appropriate to revisit the questions after each problem is summarized to further understand how the problem relates to the goals of the "Mathematical Reflections" questions.

Check-Ups, Quizzes, and Unit Tests

It is important to read the Check-Up, Quiz and Unit Test questions before teaching any of the investigations. Doing so helps the teacher understand what to emphasize in each problem. Consider assigning Additional Practice as homework before these assessments.

Transparencies and Labsheets

It is useful for students to have copies of these materials for their notebooks, especially if there is a table, graph, or a great deal of data given.

This proves to be a significant time-saver. Teachers may wish to prepare all handouts before starting a unit and keep them on file for easy reference.

Bulletin Boards

Prepare all posters and bulletin boards before starting the unit. Posters entitled "Math Terms We Are Using," "Problem Solving Strategies We Are Using," and "What's The Math?" can be posted and information can be added throughout the unit of study. Also, the "Mathematical Highlights" can be written on large paper and posted. As each

highlight is accomplished, it can be checked off. This is a good visual aid for students to monitor their progress.

"Looking Back and Looking Ahead" Unit Reflections

These reflections effectively help students summarize the unit. Consider assigning as extended homework before the Unit Test.

Overview

It is important to read the overview on page 1a to understand the rationale behind the authors' emphasis on helping students make sense of the content.

Investigation 1: *The Factor Game*

Make sure you know the rules to the game and practice the game a few times on the overhead projector with your students before you have them play each other. Consider assigning playing the game with family members for homework.

Investigation 2: *The Product Game*

Problem 2.2 can be complex for some students. They must consider the relationship between the number of products and the size of the product board. It helps to practice making product boards before students do one. Completed product game boards can be laminated and students can play with classmates and family members. This is also a good "Open House" or "Parent Night" activity.

Investigation 3: *Factor Pairs*

Students may have some experience with this activity from elementary school. It may be helpful to put the rectangles around the room so students can see them for the rest of the unit.

Investigation 4: ***Common Factors and Multiples***

Read the summary notes in the Teacher's Guide carefully for Problem 4.1. While exploring Problem 4.2, remind students of the strategies used in the previous Problem. Encourage students to notice the patterns and to generalize about how often common multiples occur between two numbers.

Investigation 5: ***Factorizations***

Problem 5.2 briefly introduces exponents. Spend more time on this concept and include examples in homework assignments. Before introducing Problem 5.3, it is helpful to practice with a few numbers before presenting the Problem to students.

Investigation 6: ***The Locker Problem***

Be sure to do this problem as a student would experience it in the classroom. Think back to your own strategies and thought processes as you worked the problem. This Investigation may take a full week including time for group sharing but is extremely effective in summarizing and reviewing content from the entire unit.

Data About Us
Teaching Notes

Reflections

Before beginning the first problem in any of the investigations, read with students the "Mathematical Reflections" at the end of each investigation. This helps students get a sense of what the investigation focuses on. It is appropriate to revisit the questions after each problem is summarized to further understand how the problem relates to the goals of the "Mathematical Reflections" questions.

Check-Ups, Quizzes, and Unit Tests

It is important to read the Check-Up, Quiz and Unit Test questions before teaching any of the investigations. Doing so helps the teacher understand what to emphasize in each problem. Consider assigning Additional Practice as homework before these assessments.

Transparencies and Labsheets

It is useful for students to have copies of these materials for their notebooks, especially if there is a table, graph, or a great deal of data given.

This proves to be a significant time-saver. Teachers may wish to prepare all handouts before starting a unit and keep them on file for easy reference.

Bulletin Boards

Prepare all posters and bulletin boards before starting the unit. Posters entitled "Math Terms We Are Using," "Problem Solving Strategies We Are Using," and "What's The Math?" can be posted and information can be added throughout the unit of study. Also, the "Mathematical Highlights" can be written on large paper and posted. As each highlight is accomplished, it can be checked off. This is a good visual aid for students to monitor their progress.

"Looking Back and Looking Ahead" Unit Reflections

These reflections effectively help students summarize the unit. Consider assigning as extended homework before the Unit Test.

Overview

It is important to read the overview on page 1a to understand the rationale behind the authors' emphasis on helping students make sense of the content.

Investigation 1: *Looking at Data*

Be sure to use the correct language when talking with students. "Mean," "median," and "mode" are all types of measures of center or measures of central tendency.

For Problem 1.1, consider having students graph the lengths of names on a bulletin board with a line plot, using index cards and post-it notes. Students can also use cubes to make a stack with the same number of cubes as letters in their names.

"Data About Us" describes range as from 7 to 17, where others would say the range is 10. Help students to understand that there are two ways to view "range."

Investigation 2: *Types of Data*

It is suggested to "launch" Problem 2.2 in two stages. First help students understand why they can not find the median or range of categorical data by using the pet data on page 24 of the student edition but having students keep books closed. When students understand the difference between categorical and numerical data, have them proceed with Problem 2.2.

Investigation 3: *Using Graphs to Group Data*

For Problem 3.2, use the data provided or conduct your own jump-rope activity.

Investigation 4: ***Coordinate Graphs***

Good ACE questions which use scatterplots are on pages 48-49 #3, and on pages 50-51 #5.

Investigation 5: ***What Do We Mean by Mean?***

Read *Teaching Notes* very carefully when introducing this Investigation.

Shapes and Designs
Teaching Notes

Reflections

Before beginning the first problem in any of the investigations, read with students the "Mathematical Reflections" at the end of each investigation. This helps students get a sense of what the investigation focuses on. It is appropriate to revisit the questions after each problem is summarized to further understand how the problem relates to the goals of the "Mathematical Reflections" questions.

Check-Ups, Quizzes, and Unit Tests

It is important to read the Check-Up, Quiz and Unit Test questions before teaching any of the investigations. Doing so helps the teacher understand what to emphasize in each problem. Consider assigning Additional Practice as homework before these assessments.

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Bulletin Boards

Prepare all posters and bulletin boards before starting the unit. Posters entitled "Math Terms We Are Using," "Problem Solving Strategies We Are Using," and "What's The Math?" can be posted and information can be added throughout the unit of study. Also, the "Mathematical Highlights" can be written on large paper and posted. As each highlight is accomplished, it can be checked off. This is a good visual aid for students to monitor their progress.

"Looking Back and Looking Ahead" Unit Reflections

These reflections effectively help students summarize the unit. Consider assigning as extended homework before the Unit Test.

Overview

It is important to read the overview on page 1a to understand the rationale behind the authors' emphasis on helping students make sense of the content.

Introduction

It is important to read the notes in the sidebars in the introduction. They refer to examples and non-examples of polygons. Line symmetry and turn symmetry are also introduced.

Investigation 1: *Bees and Polygons*

Consider introducing "angle" in this Investigation instead of waiting until later.

Investigation 2: *Building Polygons*

Students are introduced to polystrips in Problem 2.1, *Building Triangles*. Consider using spaghetti in place of polystrips. It is important in this Investigation that students know what data they are looking for and how to organize it (you might demonstrate). The polystrips are excellent for showing the stability of triangles and the instability of quadrilaterals.

While exploring polygons, include the terms *perpendicular line* and *line segment*.

Investigation 3: *Polygons and Angles*

Students need their own angle ruler or protractor to use at home. In Problem 3.3, *Developing More Angle Benchmarks*, consider making copies of the Shape Set in the Teacher's Edition on pages 129-130. Save the shape set sheets for use in Problem 3.5.

For Problem 3.3, how to use angle rulers is not introduced until Problem 3.5, so students should estimate the answers to ACE questions #19-26 should they be assigned for homework after completing Problem 3.3.

While exploring angles, include the terms *acute* and *obtuse*.

Investigation 4: *Polygon Properties and Tiling*

In Problem 4.1, *Relating Sides to Angles,* encourage students to look for patterns and make generalizations to formulas. For example, in Problems 4.1 and 4.2, if s = the number of sides of a polygon, then the sum of the interior angles of any polygon equals (s – 2) x 180. Problem 4.2 Follow-up discusses equilateral and isosceles triangles. Add the term *scalene triangle*.

Investigation 5: *Side-Angle-Shape*

See Additional Practice for Investigation 4 on page 137 for an example.

Investigation 6: *Turtle Tracks*

This Investigation is optional because the Logo program "Turtle Tracks" is needed. In lieu of the turtle program, consider having students do Additional Practice for Investigation 5 on page 138. Students should complete the Mathematical Reflections on page 63 regardless of how Investigation 6 is handled.

Bits and Pieces I
Teaching Notes

Reflections

Before beginning the first problem in any of the investigations, read with students the "Mathematical Reflections" at the end of each investigation. This helps students get a sense of what the investigation focuses on. It is appropriate to revisit the questions after each problem is summarized to further understand how the problem relates to the goals of the "Mathematical Reflections" questions.

Check-Ups, Quizzes, and Unit Tests

It is important to read the Check-Up, Quiz and Unit Test questions before teaching any of the investigations. Doing so helps the teacher understand what to emphasize in each problem. Consider assigning Additional Practice as homework before these assessments.

Transparencies and Labsheets

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This proves to be a significant time-saver. Teachers may wish to prepare all handouts before starting a unit and keep them on file for easy reference.

Bulletin Boards

Prepare all posters and bulletin boards before starting the unit. Posters entitled "Math Terms We Are Using," "Problem Solving Strategies We Are Using," and "What's The Math?" can be posted and information can be added throughout the unit of study. Also, the "Mathematical Highlights" can be written on large paper and posted. As each highlight is accomplished, it can be checked off. This is a good visual aid for students to monitor their progress.

"Looking Back and Looking Ahead" Unit Reflections

These reflections effectively help students summarize the unit. Consider assigning as extended homework before the Unit Test.

Overview

It is important to read the overview on page 1a to understand the rationale behind the authors' emphasis on helping students make sense of the content.

Investigation 1: *Fund-Raising Fractions*

When your school does fundraising, students could record profits like the model in Problem 1.1 with the thermometer to show progress. Have a copy of the Transparency 1.2 for each class because they will record information for each class so they can refer back to it when they do 1.3, 1.4, and 1.5.

Making the fraction strips in Problem 1.2 may take a whole class period. If this is the case, then consider doing the rest of 1.2 and 1.3 on the same day. Give students and envelope for fraction strips.

Investigation 2: *Comparing Fractions*

In Investigation 2.4, have students look for patterns and make generalizations about which fractions are closer to 0, 1/2 or 1. For example, students should be able to conclude that if the fraction is closer to zero, the numerator is less that a quarter of the denominator and that if the fraction is close to one-half, the numerator is close to half of the denominator.

Investigation 3: *Cooking With Fractions*

For homework, have students bring in a recipe from home that contains some fractional amounts. Then have students double the recipe or cut the recipe in half.

Investigation 4: *From Fractions to Decimals*

Students may need some review of decimal place value and terminology. Consider using Labsheet 5.1 instead of Labsheet 4.2 so students have more grids. For ACE questions #17-20, show a number line with steps during class so students understand how this model works.

Investigation 5: *Moving Between Fractions and Decimals*

Have students create addition and subtraction of decimal practice for a partner. Have the students trade papers to correct each other.

Investigation 6: *Out of One Hundred*

Read the introduction to Investigation 6 with students since it explains the meaning of "percent".

Have copies of Labsheet 6.1 available for students to use in Problem 6.1. For Problem 6.3, students need to use the hundredths grids. This is not listed in the materials section on page 66L.

Covering and Surrounding
Teaching Notes

Reflections

Before beginning the first problem in any of the investigations, read with students the "Mathematical Reflections" at the end of each investigation. This helps students get a sense of what the investigation focuses on. It is appropriate to revisit the questions after each problem is summarized to further understand how the problem relates to the goals of the "Mathematical Reflections" questions.

Check-Ups, Quizzes, and Unit Tests

It is important to read the Check-Up, Quiz and Unit Test questions before teaching any of the investigations. Doing so helps the teacher understand what to emphasize in each problem. Consider assigning Additional Practice as homework before these assessments.

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Bulletin Boards

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"Looking Back and Looking Ahead" Unit Reflections

These reflections effectively help students summarize the unit. Consider assigning as extended homework before the Unit Test.

Overview

It is important to read the overview on page 1a to understand the rationale behind the authors' emphasis on helping students make sense of the content.

Investigation 1: *Measuring Perimeter and Area*

Distribute one-inch grid paper and an envelope to each student so they can complete assignments at home.

Investigation 2: *Measuring Odd Shapes*

The ACE questions in this Investigation require some additional materials: string for #1, a city or state map for #16, a world atlas or encyclopedia for #17-21, and a transparency of centimeter grid paper for #22-23.

Investigation 3: *Constant Area, Changing Perimeter*

Consider saving ACE #7 on page 33 to use in class in conjunction with Problem 4.2. Encourage students to look for patterns and generalize about "quick" ways to find perimeter. "Add them up" (instead of counting). With variables, this would look like **l + w + l + w**. Other possible expressions are **2 x l + 2 x w** or **2(l + w)**.

Investigation 4: *Constant Perimeter, Changing Area*

In this Investigation, students begin with a fixed perimeter and explore how they area can vary. It is important that students understand which variable is held constant and which changes. Encourage students to generalize that the formula for finding the area of a rectangle is **l x w**.

Investigation 5: *Measuring Parallelograms*

For ACE question #15, have students find as many parallelograms as they can using the given constraints.

Students learn new vocabulary, "base" and "height." Have students discuss quick ways to find the area without counting the individual square units. Students should see if they rearrange the parallelogram into a rectangle, they can generalize that the formula for finding the area of a parallelogram is **b x h.**

Investigation 6: *Measuring Triangles*

For Problem 6.1, it is helpful to make copies of Transparency 6.1 for students. Students should build on the vocabulary developed in Investigation 5 (base and height), and the formula (b x h) to generalize to the area of triangles. Students might see this as **(b x h)/2** rather than **1/2 bh.**

Investigation 7: *Going Around in Circles*

This is an important Investigation. Students discover how the diameter of a circle is related to its circumference and area. The concept of pi is developed.

Problem 7.1 identifies circle parts. Add the terms *chord, point,* and *tangent.* Problems 7.1 and 7.2 involve circumference. Encourage students to generalize a formula for circumference. They may arrive at **C/d** is about equal to 3 or **3 x d** is about equal to the circumference. Introduce π, and generalize a formula for circumference ($\mathbf{C = d\pi}$). Problems 7.3, 7.4, and 7.5 involve the area of a circle. By the end of Problem 7.4, students should generalize $\mathbf{r^2 \times \pi}$.

How Likely Is It?
Teaching Notes

Reflections

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Check-Ups, Quizzes, and Unit Tests

It is important to read the Check-Up, Quiz and Unit Test questions before teaching any of the investigations. Doing so helps the teacher understand what to emphasize in each problem. Consider assigning Additional Practice as homework before these assessments.

Transparencies and Labsheets

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This proves to be a significant time-saver. Teachers may wish to prepare all handouts before starting a unit and keep them on file for easy reference.

Bulletin Boards

Prepare all posters and bulletin boards before starting the unit. Posters entitled "Math Terms We Are Using," "Problem Solving Strategies We Are Using," and "What's The Math?" can be posted and information can be added throughout the unit of study. Also, the "Mathematical Highlights" can be written on large paper and posted. As each highlight is accomplished, it can be checked off. This is a good visual aid for students to monitor their progress.

"Looking Back and Looking Ahead" Unit Reflections

These reflections effectively help students summarize the unit. Consider assigning as extended homework before the Unit Test.

Overview

It is important to read the overview on page 1a to understand the rationale behind the authors' emphasis on helping students make sense of the content.

Investigation 1: *A First Look at Chance*

Summarize Problem 1.1 carefully. When combining the class's data, add the data one group at a time, re-computing the fraction and percent of heads each time.

Investigation 2: *More Experiments with Chance*

Students need both large and small marshmallows for Problem 2.1 and they work best is they are removed from the bag and straightened instead of mashed. Let them dry for at least two or three days.

Alternative ACE assignment: Option A: 3, 5 – 13; Option B: 8-13, 17

Investigation 3: *Using Spinners to Predict Chances*

In Problem 3.1 consider reviewing how to construct a circle graph prior to assigning ACE questions 9 – 12. This is importance since the skill is included on Check-Up 1. This problem may take more than one day.

Investigation 4: *Theoretical Probabilities*

Read *Teaching Notes* very carefully when introducing this Investigation.

Investigation 5: *Analyzing Games of Chance*

The Unit Test includes problems about the outcome of rolling one or more dice. Do Problem 5.1 Follow-up and ACE questions #3 – 10 on pages 44-45 to prepare for the test.

Investigation 6: *More About Games of Chance*

Read *Teaching Notes* very carefully when introducing this Investigation.

Investigation 7: *Probability and Genetics*

Tiles or coins with X's, Y's and Z's are needed for the assessments. They should be kept in cups for the students to draw from.

Bits and Pieces II
Teaching Notes

Reflections

Before beginning the first problem in any of the investigations, read with students the "Mathematical Reflections" at the end of each investigation. This helps students get a sense of what the investigation focuses on. It is appropriate to revisit the questions after each problem is summarized to further understand how the problem relates to the goals of the "Mathematical Reflections" questions.

Check-Ups, Quizzes, and Unit Tests

It is important to read the Check-Up, Quiz and Unit Test questions before teaching any of the investigations. Doing so helps the teacher understand what to emphasize in each problem. Consider assigning Additional Practice as homework before these assessments.

Transparencies and Labsheets

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Bulletin Boards

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"Looking Back and Looking Ahead" Unit Reflections

These reflections effectively help students summarize the unit. Consider assigning as extended homework before the Unit Test.

Overview

It is important to read the overview on page 1a to understand the rationale behind the authors' emphasis on helping students make sense of the content.

Prior to the Start of the Unit

Consider reviewing some of the key concepts from Bits and Pieces I, especially from Problems 2.2, 2.3, 2.4, 4.2, 4.3, 5.1, 5.2, and 6.2.

Investigation 1: *Using Percents*

Begin collecting advertisements listing "percent off" for use with Problem 1.3. As an extension for Problem 1.2, have each group member order different items and compute each person's total if the bill is not shared equally.

Investigation 2: *More About Percents*

Have students search for advertisements that contain percents and have them create word problems for each other.

Investigation 3: *Estimating With Fractions and Decimals*

Prepare the game pieces for Problems 3.1 and 3.2 well ahead. For Problem 3.2, a large number line with fractions/decimals/percents makes a useful wall poster or make a game with a blank number line and have the students properly place the various fractions, decimals and percents. For Problem 3.2 Follow-up, consider adding 1/8 to the list of fractions students should know.

Investigation 4: ***Adding and Subtracting Fractions***

Save a transparency of answers for Problem 4.1 to use as review with Problem 4.2. For Problem 4.4, some teachers have groups of 2 or 3 create posters. They display all posters at once discussing for each poster: *Does this poster make sense? Is it easy to follow the steps?* Then determine which posters to leave up.

Investigation 5: ***Finding Area and Other Products***

An alternative for Problem 5.1 is to use grid paper and draw a 4 by 6 pan rather than use copies of the square pans. Each square is $1.00 worth of brownie and the 4 by 6 rectangle can be divided into thirds and halves. The brownie pan does not have to be a square pan as indicated.

Investigation 6: ***Computing With Decimals***

Prepare the *School Supply Game* boards (Labsheet 6.1) ahead of time. In Problem 6.3, you might review once again how to use the fraction/decimal key on the scientific calculator.

Investigation 7: ***Dividing Fractions***

This Investigation was only added to the Unit for use starting in September of 2001. The Investigation begins by having students think carefully about division of whole numbers in order to link to division of fractions. Students then divide whole numbers by fractions and fractions by whole numbers. This is followed by division of a fraction by another fraction. The goal of the Investigation is to help students develop an efficient algorithm for dividing fractions. Calculators are NOT encouraged.

Ruins of Montarek
Teaching Notes

Reflections

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Bulletin Boards

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highlight is accomplished, it can be checked off. This is a good visual aid for students to monitor their progress.

"Looking Back and Looking Ahead" Unit Reflections

These reflections effectively help students summarize the unit. Consider assigning as extended homework before the Unit Test.

Overview

It is important to read the overview on page 1a to understand the rationale behind the authors' emphasis on helping students make sense of the content.

Investigation 1: *Building Plans*

Have students make a building mat that they keep for this unit. Encourage students to turn mats to see each view (front, back, etc.) and to position themselves at eye level. Some of the ACE questions require the use of a mirror. If students do not have a mirror at home, they may use aluminum foil wrapped around cardboard.

Investigation 2: *Making Buildings*

Students needing additional challenges can be required to give maximum/minimal views whenever possible. It is recommended that the teacher purchases a box of sugar cubes to use instead of blocks.

Investigation 3: *Describing Unique Buildings*

For Problem 3.1, make sure students understand the concept of "unique."

Investigation 4: *Isometric Dot Paper Representations*

Read *Teaching Notes* carefully when introducing isometric dot paper representations.

Investigation 5: *Ziggurats*

For additional examples of problems where a cube "building" is illustrated and students must determine the total number of cubes used to make the structure, see ACE questions #6 – 7 from pages 59 – 60, and #9 on page 70, and #7 on page 80.

Investigation 6: *Seeing the Isometric View*

Read *Teaching Notes* carefully when introducing isometric dot paper representations.

7th Grade Units

Variables and Patterns
Teaching Notes

Reflections

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highlight is accomplished, it can be checked off. This is a good visual aid for students to monitor their progress.

"Looking Back and Looking Ahead" Unit Reflections

These reflections effectively help students summarize the unit. Consider assigning as extended homework before the Unit Test.

Overview

It is important to read the overview on page 1a to understand the rationale behind the authors' emphasis on helping students make sense of the content.

Investigation 1: *Variables and Coordinate Graphs*

Problem 1.1 can be confusing for students if directions are not modeled and followed carefully. The counting is to be continuous. The counter calls out the number that he or she is on when the timer says, "time." The jumper jumps continuously, not stopping after each ten seconds. The timer says, "go," then in ten seconds he or she says, "time," and the counter says the number, i.e. "19," then continues counting 20, 21, 22 quietly. Then in another ten seconds, the timer says, "time," and the counter says the number that he or she is counting at that time. While this is going on, the recorder writes down the numbers called out by the counter. This continues for the two minutes. Save the data collected in Problem 1.1 for use in the follow-up.

Investigation 2: *Graphing Change*

In Problem 2.1, some students have difficulty putting a lot of imagination into the story line. They need to understand that they are being asked to be imaginative in this and the following problems. There is an error in the Teacher's Edition for Problem 2.2, answer B: the most progress is made during the first half-hour, 8 miles.

Good practice for test problems involving tables and graphs appear in ACE questions #2, 6, 7, 9, and 10 on pages 27 – 32.

Investigation 3: ***Analyzing Graphs and Tables***

Save the work students do in Problem 3.4 for use in Problem 4.3. The table lends itself to being done with a spreadsheet if you have the technology available.

Good practice for test problems involving tables and graphs appear in ACE questions #3, 5, 7, and 8 on pages 42 - 46.

Investigation 4: ***Patterns and Rules***

Good practice for test problems involving solving equations appear in ACE question #10 on page 57.

Investigation 5: ***Using a Graphing Calculator***

These lessons can involve quite a bit of time for students to become comfortable with the new technology. If the time is taken now, the graphing calculator can be an incredible resource throughout the remainder of the curriculum.

Stretching and Shrinking
Teaching Notes

Reflections

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highlight is accomplished, it can be checked off. This is a good visual aid for students to monitor their progress.

"Looking Back and Looking Ahead" Unit Reflections

These reflections effectively help students summarize the unit. Consider assigning as extended homework before the Unit Test.

Overview

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Investigation 1: *Enlarging Figures*

In Problem 1.1, crayons work well for enlarging figures because the rubber bands won't slide up and down as much as they do on a pencil or the students could use masking tape to hold. It is important to show students the A and A' notation and to discuss the concept of corresponding sides. Using stiffer rubber bands makes the images more believable. Using larger paper for the image is easier for students to work with. Pass out long strips of masking tape for students to share within their groups.

For ACE question #3, consider photocopying the figure so that students don't have to copy it.

Investigation 2: Similar Figures

Use the term "image" when talking about Problem 2.1 because it is used in the assessment. Encourage students to analyze and generalize to an algebraic expression.

For Problem 2.2 you can use the blackline master copy of Transparency 2.2B instead of having students copy the chart. The Follow-up is essential. This is where the concept of

scale factor is introduced. Encourage students to use the chart to analyze and describe patterns and to ultimately generalize to an algebraic expression.

Investigation 3: *Patterns of Similar Figures*

Problem 3.1 may be completed quickly, allowing you to combine with the "Launch" to Problem 3.2. Be careful when photocopying Labsheet 3.2 so that it is an exact copy. If using shape sets for this problem, students will need two shape sets for each group to make the reptiles. The number of shapes completed is not as important as seeing the pattern.

In Problem 3.3, encourage students to look for patterns and to make generalizations leading to algebraic expressions.

Investigation 4: *Using Similarity*

In Problem 4.1, approximate measures work best to achieve desired results. Remember that the photograph in the Teacher's Guide is a reduced version of the student text. Some ACE questions do not use "friendly" numbers and you may want to choose to use alternative practice problems.

Good practice for test problems involving scale drawings and ratios to determine distances appear in ACE questions #9 on page 50 and #23 on page 56.

Investigation 5: *Similar Triangles*

This Investigation is weather dependent. There must be sun to provide shadows.

Good practice for test problems involving scale drawings and ratios to determine distances appear in ACE questions #3 - 9 on pages 65 - 68.

Investigation 6: *Stretching and Shrinking with a Computer*

This Investigation is computer dependent using either *Turtle Math* or a version of *Logo*.

Comparing and Scaling
Teaching Notes

Reflections

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Check-Ups, Quizzes, and Unit Tests

It is important to read the Check-Up, Quiz and Unit Test questions before teaching any of the investigations. Doing so helps the teacher understand what to emphasize in each problem. Consider assigning Additional Practice as homework before these assessments.

Transparencies and Labsheets

It is useful for students to have copies of these materials for their notebooks, especially if there is a table, graph, or a great deal of data given.

This proves to be a significant time-saver. Teachers may wish to prepare all handouts before starting a unit and keep them on file for easy reference.

Bulletin Boards

Prepare all posters and bulletin boards before starting the unit. Posters entitled "Math Terms We Are Using," "Problem Solving Strategies We Are Using," and "What's The Math?" can be posted and information can be added throughout the unit of study. Also, the "Mathematical Highlights" can be written on large paper and posted. As each

highlight is accomplished, it can be checked off. This is a good visual aid for students to monitor their progress.

"Looking Back and Looking Ahead" Unit Reflections

These reflections effectively help students summarize the unit. Consider assigning as extended homework before the Unit Test.

Overview

It is important to read the overview on page 1a to understand the rationale behind the authors' emphasis on helping students make sense of the content.

Investigation 1: *Making Comparisons*

Bring in actual products and prices to "launch" Problem 1.1. Be aware of those students who compare two quantities only by finding the difference between the quantities. These students may need special attention as the unit progresses.

Using Transparency 1.1 keeps students from having to flip back-and-forth in their student book.

Before starting Problem 1.2, consider conducting a class survey on television watching versus radio listening so you can compare the class results with Neilson Middle School as you complete the Follow-up.

For Problem 1.3, the "Explore" section on page 15c in the Teacher's Notes provides suggestions on how to deal with the size of the numbers in the Investigation.

Investigation 2: *Comparing by Finding Percents*

For Problem 2.1, do the survey suggested in the "Think About This!" box on page 16. Save the results for later comparisons. Don't skip the "Did You Know?" box on page 18. There are some wonderful statistics of a practical nature for students to consider. Students could create their own word problems to accompany these statistics.

Good practice for test problems involving ordering of fractions appear in ACE question #9 on page 23. Good practice for test problems involving estimating to determine accuracy appear in ACE questions #9 - 11 on page 21. Have students round to "friendly" numbers and estimate the percent before using a calculator to determine actual percent.

Check-Up 1

A few adjustments are recommended: Add an additional column and row to the table labeled, "Total." For question #8, add, "a. What is the savings?" Change question "b" to read, "What percent savings is this?" Change question "c" to read, "What would the sale price have to be for a buyer to receive a 25% discount?"

Investigation 3: *Comparing by Using Ratios*

Be sure to focus on the introduction on pages 26 – 27. Part-part versus part-whole comparisons are discussed. Also, the three ways to write ratios are presented.

Investigation 4: *Comparing by Finding Rates*

Again, it is important to go over the introduction on pages 37- 38.

In Problem 4.2, two big ideas are introduced—unit rates and rate tables. Gas mileage of the family car is a unit rate families could discuss.

Good practice for test problems involving relating tables to a written description or equation appear in ACE questions #10, 11, 22, and 23 on pages 47 - 50.

Investigation 5: ***Estimating Populations and Population Densities***

For Problem 5.1, you might copy the blackline master for Transparency 5.1 for students to use to estimate the number of dots. Note that The World Almanac for Kids lists Oregon's 1997 population as 3,243,487 and the are of the state as 98,386 square miles.

Investigation 6: ***Choosing Strategies***

This Investigation uses proportional reasoning to solve problems. An algebraic algorithm is not necessary here.

Accentuate the Negative
Teaching Notes

Reflections

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Check-Ups, Quizzes, and Unit Tests

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Bulletin Boards

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highlight is accomplished, it can be checked off. This is a good visual aid for students to monitor their progress.

"Looking Back and Looking Ahead" Unit Reflections

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Overview

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Investigation 1: *Extending the Number Line*

This Investigation introduces the "Big Ideas" in the Unit. The transparency of the thermometer is helpful for use in Problem 1.3.

Investigation 2: *Adding Integers*

For Problem 2.1, have available enlarged copies of number lines for students who have difficulty with fine motor skills. Consider providing rulers for neat and accurate results. After the presentation of the strategy used for addition in the student text, allow time to give additional problems. Students could make up some problems to model on their chipboard.

In Problem 2.2, it's helpful to use a transparency of a chipboard and transparent chips to illustrate the chip board. As with all CMP units, make sure to study the summary notes carefully as they provide helpful information about summarizing the Investigation.

Investigation 3: *Subtracting Integers*

In Problem 3.1, emphasize the concept of what makes a zero on the chipboard.

Many number lines and additional practice may be required in Problem 3.2.

Use a transparency and transparent chips to "launch" Problem 3.4. Consider asking students to provide an example of "undoing" using a simple sentence before they try the problems.

Investigation 4: *Multiplying and Dividing Integers*

As an extension for Problem 4.1, students could write an equation to describe each temperature change in parts A and B.

For Problem 4.3, use the Integer Product Game transparency and transparent markers to play the game as a whole class; divide the class into two groups. Keep this game in mind as a warm-up activity for future reference. Copy the transparency for students to use; it is larger. If the student version is used (Labsheet 4.3) use the smaller paper clips. Use game markers to avoid having to make more copies of the Labsheet and remind students not to write on the sheet.

Investigation 5: *Coordinate Grids*

In Problem 5.2, students might need additional information about a "break even" point. Remind students of the bicycle trip from *Variables and Patterns*. Students should save their work from Problem 5.2 for use with Problem 5.5.

Moving Straight Ahead
Teaching Notes

Reflections

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Check-Ups, Quizzes, and Unit Tests

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"Looking Back and Looking Ahead" Unit Reflections

These reflections effectively help students summarize the unit. Consider assigning as extended homework before the Unit Test.

Overview

It is important to read the overview on page 1a to understand the rationale behind the authors' emphasis on helping students make sense of the content.

Investigation 1: *Predicting From Patterns*

The two experiments may take a great deal of class time to organize and to execute. If conducting the experiment is not the main objective, consider using the sample data given in the Teacher's Guide for students to use in the Problems.

Investigation 2: *Walking Rates*

Make sure students do the Follow-up for Problem 2.2 since it explicitly addresses graphs of linear equations.

Spend quality time on Problem 2.3 as it is referred back to throughout the remainder of the unit.

The Follow-up for Problem 2.5 is essential.

Emphasize the relationships between the story, charts, graphs and equations. Help students generalize that a linear relationship has a constant rate of change. Have students notice the steepness of the slope an make predictions about how the coefficient of x will change the slope.

Investigation 3: *Exploring Lines with a Graphing Calculator*

The concept of a coefficient and the y-intercept in the slope-intercept form of linear equations ($y = mx + b$) is clearly developed in Problem 3.4. Emphasize the relationships between the story, charts, graphs and equations. Help students generalize that a linear relationship has a constant rate of change. Have students notice the steepness of the line by analyzing the slope and make predictions about how the coefficient of x will change the steepness of the line.

Investigation 4: *Solving Equations*

The symbolic method is described in detail in Problem 4.2. This method for solving equations will be fully mastered by students after the 8th grade algebra unit of study entitled, *Say It With Symbols*.

Investigation 5: *Exploring Slope*

The concepts that are encountered in this Investigation will be fully mastered by students after the 8th grade algebra unit of study entitled, *Say It With Symbols*.

Investigation 6: *Writing an Equation for a Line*

The concepts that are encountered in this Investigation will be fully mastered by students after the 8th grade algebra unit of study entitled, *Say It With Symbols*.

Filling and Wrapping
Teaching Notes

Reflections

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Check-Ups, Quizzes, and Unit Tests

It is important to read the Check-Up, Quiz and Unit Test questions before teaching any of the investigations. Doing so helps the teacher understand what to emphasize in each problem. Consider assigning Additional Practice as homework before these assessments.

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"Looking Back and Looking Ahead" Unit Reflections

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Overview

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Investigation 1: *Building Boxes*

Ask students to bring in small boxes such as candy boxes, cereal boxes or juice boxes. They will be needed in Problem 1.3.

By Problem 1.4, encourage students to look for strategies for quick ways of finding surface area, having them generalize to an algebraic expression.

Investigation 2: *Designing Packages*

Be sure to view the video from *Modeling Middle School Mathematics* entitled, *Designing Packages – Measurement – Grade 7* which is about 37 minutes in length. Take the opportunity to visit and reflect on a class through a video lesson from this exemplary program and gain the support necessary to implement this mathematically significant unit.

Follow-up questions from Problem 2.2 are useful as a quick assessment of whether students understand the key ideas in Investigation 2.

Investigation 3: ***Finding Volumes of Boxes***

Problem 3.3 may work better in pairs or small groups rather than individually. It requires a fair amount of 8 1/2 inch by 11 inch paper. Consider keeping a recycling box and use scrap paper from there.

Good practice for test problems involving requiring students to find the volume and surface area of a rectangular prism appear in ACE questions #1 – 10 on pages 29 – 32.

Investigation 4: ***Cylinders***

The cylinder is made from a transparent grid that has been cut into strips. The grid should be small enough to get ten vertical lines in about two inches. You can use a smaller diameter of clay than that which the book suggests. The concepts in this Investigation will be carried over into the next Investigation in order to provide relationships for comparing solids.

Investigation 5: ***Cones and Spheres***

This Investigation can be physically challenging to do so be sure to try it ahead of time. It is a wonderful way to learn the relationship between cylinders, cones, and spheres.

Investigation 6: ***Scaling Boxes***

In some schools, the science teachers are willing to do Problem 6.2 with students.

Investigation 7: ***Finding Volume of Irregular Objects***

This Investigation is quite difficult for students. Consider having students estimate volumes and surface areas of various irregular objects.

What Do You Expect?
Teaching Notes

Reflections

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"Looking Back and Looking Ahead" Unit Reflections

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Overview

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Investigation 1: *Evaluating Games of Chance*

The Follow-up to Problem 1.1 is essential because of the vocabulary that is developed, such as, "equally likely."

Good practice for test problems involving "fair games" and drawing objects from a container appear in ACE questions #10 – 11 on page 17 and #20 on page 20.

Investigation 2: *Analyzing Number-Cube Games*

Introduce by playing Roller Derby (from *How Likely Is It?* Problem 5.1). The activity provides a helpful review of the concepts students will encounter in this Investigation.

Good practice for test problems involving rolling one or more dice appear in ACE questions #1 – 4, 7 – 9, 17 on pages 24 - 28.

Investigation 3: *Probability and Area*

The Treasure Hunt Game is available for download from the CMP website.

Mac version: http://www.math.msu.edu/cmp/HuntDocM.html

PC version: http://www.math.msu.edu/cmp/HuntDocW.html

Investigation 4: *Analyzing Two Stage Games*

Read the Teacher Notes from the Teacher's Guide carefully beforehand.

Investigation 5: *Expected Value*

Expected value is introduced through basketball foul shot percentages. Not all students understand this basketball concept. It needs to be demonstrated.

For Problem 5.1, consider demonstrating the theoretical probability using an area model for a one-and-one foul shot percentage shooter. Also, show the difference between that and a two-shot percentage shooter. Assign students to find the theoretical probability of each percentage shooter in a one-and-one and two-shot situation using 10 by 10 array grid paper. Cut these grids out and place onto lined paper, leaving room under each for computing the average points per trip or expected value. Make sure students label their work.

Several of the ACE questions in previous Investigations have asked for analyzing point structure or money value in carnival games. All these situations are leading to expected value, or the "average." Be careful! When talking about "what is most likely" and finding the "average points per trip" to the foul line, this is not the same question. Make sure to study the Teacher's Notes on pages 58c – 58h before beginning Investigation 5.

Investigation 6: *Carnival Games*

Read the Teacher Notes from the Teacher's Guide carefully beforehand.

Investigation 7: *Analyzing Sequences of Outcomes*

Read the Teacher Notes from the Teacher's Guide carefully beforehand.

Data Around Us
Teaching Notes

Reflections

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"Looking Back and Looking Ahead" Unit Reflections

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Overview

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Investigation 1: *Interpreting Disaster Reports*

This Investigation introduces the "big ideas" in the unit. In Problem 1.1, consider collecting several days of newspapers and provide each group with a page or section. The group's task is to find numbers and list as either "accurate" or "estimate." Students could make posters with examples and rationales for each number collected and present their findings to the class.

Investigation 2: *Measuring Oil Spills*

This Investigation and the next two are the heart of the unit. Problem 2.1 and the Follow-up may take only part of the class period. Consider beginning Problem 2.2 if this happens.

A strategy that works in Problem 2.3 is to assign each of the tasks in parts A – G to groups of students to complete, record, and present to the rest of the class.

Investigation 3: *Comparing Large Numbers*

The two variations in the Follow-up to Problem 3.1 make this a more interesting, complex activity. Also, rolling a ten-sided die works as well as the spinner.

Problem 3.2 can be done on the same day as Problem 3.1.

Problem 3.3 is complex. Don't rush this lesson. Numbers from the newspaper can be used as further examples.

Investigation 4: *How Many Is a Million*

In Problem 4.1, parts A – D can be assigned to groups to complete, record and present. Consider doing Problem 4.2 as an "act-it-out" demonstration using base-ten materials and meter sticks.

Problem 4.3 is covered quickly. Students might need additional practice with this concept. The ACE questions provide some practice. Number 21 in the Question Bank on page 77, and problems 1 and 2 in the Additional Practice for Investigation 4 on page 131 deal with scientific notation.

Good practice for test problems involving problems about exponents and/or scientific notation appear in ACE questions #6 – 10, 13, 14 on pages 44 – 46.

Investigation 5: *Every Litter Bit Hurts*

The Problems in this Investigation build nicely on the ideas in the Unit *Comparing and Scaling*. In Problem 5.2, students also encounter measures of central tendency.

Investigation 6: *On an Average Day*

This Investigation allows students to apply all of the strategies, including subtraction, division, and unit rates, they have developed for comparing and making sense of large numbers. In Problem 6.2, students explicitly look at comparison by subtraction versus division. In Problem 6.3, comparisons using rates is explicitly used.

8th Grade Units

Thinking With Mathematical Models
Teaching Notes

Reflections

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"Looking Back and Looking Ahead" Unit Reflections

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Overview

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Investigation 1: *Linear Models*

The experiment in Problem 1.1 may take a great deal of class time to organize and to execute. If conducting the experiment is not the main objective, consider using the sample data given in the Teacher's Guide for students to use in the Problems.

Consider having students use graph paper for each problem in each Investigation in this entire unit.

There is a great deal of practice problems in the ACE questions which should be assigned and gone over thoroughly.

Investigation 2: *Nonlinear Models*

The experiment in Problem 2.1 may take a great deal of class time to organize and to execute. If conducting the experiment is not the main objective, consider using the sample data given in the Teacher's Guide for students to use in the Problems.

Consider using a real balance to demonstrate the set up of Problem 2.2.

For Problem 2.3, consider extending the table up to 100 miles per hour to continue the graph and notice the pattern of change.

Investigation 3: ***More Nonlinear Models***

Have students make accurate predictions for Problem 3.1 before showing them the set up of the chart in the Follow-up.

The experiment in Problem 3.2 may take a great deal of class time to organize and to execute. If conducting the experiment is not the main objective, consider using the sample data given in the Teacher's Guide for students to use in the Problems.

Investigation 4: ***A World of Patterns***

For each Problem in Investigation 4, consider having groups record and present their findings to the rest of the class using large chart paper.

The stories the students write will allow for a bit of creativity. Consider using this writing as a portfolio entry or display on a bulletin board.

Looking for Pythagoras
Teaching Notes

Reflections

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Check-Ups, Quizzes, and Unit Tests

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Overview

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Investigation 1: *Locating Points*

For Problem 1.1, be sure to discuss part C with students to begin to develop the idea of the length of the hypotenuse. Make additional copies of the town of Euclid. It works to reduce Labsheet 1.3. Each student will probably need four copies throughout this Investigation.

Investigation 2: *Finding Areas and Lengths*

For Problem 2.3, it may be helpful to pre-draw lines on dot paper for students, placing the dots appropriately with enough room for students to draw necessary squares on paper as well. Then direct the students through the strategies in Problem 2.3, giving time for practice.

Investigation 3: *The Pythagoren Theorem*

For Problem 3.1, consider pre-drawing triangles on dot paper to allow space for the addition of squares on all sides of the triangles. The essential idea of this activity is found in part C of this Problem. Help students find this connection.

For Problem 3.2, consider copying Labsheets 3.2A, 3.2B, and 3.2C on different colors, laminate, and cut out the shaded pieces. Give one set to each group.

Good practice for using the Pythagorean Theorem can be found in ACE questions #1 – 6, 9 on pages 46 – 50, and #8 – 11 on page 35, and #27a on page 39.

Investigation 4: ***Using the Pythagorean Theorem***

The Extension questions #10 – 12 on pages 50 – 51 are quite challenging and could be used as class investigations in groups. Have students create another such example which satisfies the rule.

Investigation 5: ***Irrational Numbers***

This Investigation is very important and can be difficult for students. Irrational Numbers are introduced while reviewing fraction and decimal concepts.

Investigation 6: ***Rational and Irrational Slopes***

Students explore interesting applications of irrational numbers in this Investigation. Irrational slopes are used to play a video game. The relationships between slopes of parallel lines and perpendicular lines are also discussed.

Growing, Growing, Growing
Teaching Notes

Reflections

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These reflections effectively help students summarize the unit. Consider assigning as extended homework before the Unit Test.

Overview

It is important to read the overview on page 1a to understand the rationale behind the authors' emphasis on helping students make sense of the content.

Investigation 1: *Exponential Growth*

There are many tables to construct in this unit. Consider photocopying Transparencies and Labsheets for students that involve tables and graphs. It will save significant class time.

It is essential to assign and discuss the Follow-up for each Problem in this unit. The Follow-up for each Problem makes the mathematics more explicit.

The technology notes beginning on page 1g has useful information about using a graphing calculator to perform recursive multiplication and explore sums of sequences (among other topics) with this unit.

It is important to read the Introduction with students. It explains the difference between linear and exponential growth.

The first Investigation introduces the idea of exponential growth. In Problem 1.1, students can tear the paper carefully instead of using scissors if they are not readily available. Calculators should be accessible to students, especially for the Follow-up.

Discuss powers of two during the summary. The Teaching Notes on page 16b provide more information.

In Problem 1.2, the *ruba* context is introduced. Note that the ruba plans will surface again in the future so be sure to read the Teaching Notes for each Investigation to be clear about how the story develops.

Good practice for test problems involving patterns, tables and exponents appear in ACE questions #2, 4 – 9, and 15 on pages 10 – 14.

Investigation 2: *Growth Patterns*

Students might actually grow mold. Directions are given on page 30e. This Investigation along with the next three Investigations, make up the heart of the unit.

Consider having students make one big chart which outlines each of the *ruba* plans involved in the story in order that students may compare. See included sample. Also consider having students use a computer spreadsheet to construct a large table of the data from the story.

Also consider having students graph the data from their tables all on one coordinate grid.

Investigation 3: *Growth Factors*

Compound growth is introduced in Problem 3.2. Many real-life examples could be used here.

Investigation 4: *Exponential Decay*

This is an important Investigation because exponential decay is introduced. Students might conduct the Cooling Water experiment in Problem 4.4.

Frogs, Fleas, and Painted Cubes
Teaching Notes

Reflections

Before beginning the first problem in any of the investigations, read with students the "Mathematical Reflections" at the end of each investigation. This helps students get a sense of what the investigation focuses on. It is appropriate to revisit the questions after each problem is summarized to further understand how the problem relates to the goals of the "Mathematical Reflections" questions.

Check-Ups, Quizzes, and Unit Tests

It is important to read the Check-Up, Quiz and Unit Test questions before teaching any of the investigations. Doing so helps the teacher understand what to emphasize in each problem. Consider assigning Additional Practice as homework before these assessments.

Transparencies and Labsheets

It is useful for students to have copies of these materials for their notebooks, especially if there is a table, graph, or a great deal of data given.

This proves to be a significant time-saver. Teachers may wish to prepare all handouts before starting a unit and keep them on file for easy reference.

Bulletin Boards

Prepare all posters and bulletin boards before starting the unit. Posters entitled "Math Terms We Are Using," "Problem Solving Strategies We Are Using," and "What's The Math?" can be posted and information can be added throughout the unit of study. Also, the "Mathematical Highlights" can be written on large paper and posted. As each

highlight is accomplished, it can be checked off. This is a good visual aid for students to monitor their progress.

"Looking Back and Looking Ahead" Unit Reflections

These reflections effectively help students summarize the unit. Consider assigning as extended homework before the Unit Test.

Overview

It is important to read the overview on page 1a to understand the rationale behind the authors' emphasis on helping students make sense of the content.

Investigation 1: *Introduction to Quadratic Relationships*

Consider starting with Problem 1.2 entitled, *Reading a Graph*.

Spend plenty of time on Problem 1.3 entitled, *Writing an Equation* since labeling the sides in terms of lengths can be complex for students. Problem 1.3 also sets the stage for Investigation 2. Preview the Teaching Notes carefully for specific examples. Use ACE questions #1, 2, and 6 as additional practice for Problem 1.3 concepts involving equation writing.

Investigation 2: *Quadratic Expressions*

The *Think About This* section can be done as a warm up discussion before beginning Problem 2.1. Algebra tiles may be helpful for this Investigation.

In Problem 2.2, be aware that some students may be comfortable expanding in both dimensions instead of only one. It is essential to do Follow-up 2.2 because it introduces the terms *expanded form* and *factored form*.

Follow-up 2.3 is also essential, introducing the vocabulary *like terms*.

In Problem 2.4, spend plenty of time helping students understand the big ideas and terminology.

ACE questions #22 – 26 do a nice job helping students think about what they need to know about linear, quadratic and exponential relationships. ACE questions #5 – 9 provide more practice with writing expressions in factored form and expanded form.

Investigation 3: *Quadratic Patterns of Change*

Problem 3.2 and ACE questions #2 – 3 on pages 45 – 46, and #18 on page 50 provide students with opportunities to extend a pattern or find a specific term in a pattern.

Investigation 4: *What Is a Quadratic Function?*

Spend plenty of time on Problem 4.2. Students learn where the unit gets its name. Problem 4.3 highlights finite differences and helps students put everything together.

Investigation 5: *Painted Cubes*

See additional handouts for a nice way to have students collect and display their findings.

Say It With Symbols
Teaching Notes

Reflections

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Overview

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Investigation 1: *Order of Operations*

Preview the Investigation carefully to understand the essence of the Investigation.

ACE questions #1 – 27 provide more practice with evaluating expressions.

Investigation 2: *Equivalent Expressions*

Algebra tiles can be useful for student groups for exploration throughout this Investigation.

Investigation 3: *Some Important Properties*

The authors call the commutative property the *rearrangement property*.

Read the Follow-up questions carefully. They are an excellent source for practice problems.

Follow-up for Problem 3.3 deals with using the area formula for a trapezoid.

Follow-up for Problem 3.4 is also essential.

ACE questions #1 – 9, 13 – 20, and 30 – 32 provide good additional practice.

Investigation 4: ***Solving Equations***

This Investigation is the heart of the unit. Help students emphasize the similarities and differences between linear and quadratic equations.

Investigation 5: ***Writing Expressions for Surface Area***

Be sure to spend ample time having students solve linear equations.

Kaleidoscopes, Hubcaps, and Mirrors
Teaching Notes

Reflections

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Check-Ups, Quizzes, and Unit Tests

It is important to read the Check-Up, Quiz and Unit Test questions before teaching any of the investigations. Doing so helps the teacher understand what to emphasize in each problem. Consider assigning Additional Practice as homework before these assessments.

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"Looking Back and Looking Ahead" Unit Reflections

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Overview

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Investigation 1: *Three Types of Symmetry*

A great source of tracing paper is from the grocer – donut handling or meat separating papers (sometimes called patty paper).

Consider finding additional examples of translational symmetry (using just one design) before doing the activities in Problem 1.4. Some students find that the designs in Problem 1.4 on page 13 are combinations of transformations. In the given designs, lead students carefully through the process of finding the smallest basic element that could slide.

For more practice with problems about transformations, assign ACE questions #1 – 3, and 13 – 18 on pages 15 – 18.

Investigation 2: *Symmetry Transformations*

Transformations over lines sometimes are complicated for students. The Teacher's Guide provides helpful guidance in the Teaching Notes. Consider using your own drawings or drawings from the Additional Practice for these activities. The sketches that

begin by crossing the line of reflection in Problem 2.1 Follow-up #2 are difficult for some to visualize.

Investigation 3: *Transforming Coordinates*

For more practice with problems about transformations on a Cartesian plane, assign ACE questions #6 – 15 on pages 52 – 53.

Investigation 4: *Symmetry and Algebra*

Be sure to have plenty of copies of *Triangle ABC* and *Square ABCD* and Labsheets 4.1A, 4.1B, 4.ACE, 4.2A, and 4.2B available for student use.

Samples and Populations
Teaching Notes

Reflections

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Check-Ups, Quizzes, and Unit Tests

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Overview

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Investigation 1: *Comparing Data Sets*

Consider reviewing measures of central tendency such as mean, median, mode, range, and line plots, and bar graphs before beginning this Investigation. Students might be surveyed on a topic of their choice and that data could be used as a basis for review. Review could also come from the Additional Practice in CMP's *Data About Us*.

Consider having students color code their copy of the *Peanut Butter Survey* worksheet for easy reading.

ACE question #9 is a good opportunity to assess the class' knowledge of writing equations from a given line after completing Problem 1.5.

Emphasize the relationship between the variables on the scatterplot and show and and interpret other examples of scatterplots. Use ACE questions #2, 7, and 9 on pages 16 – 22 for additional practice.

Investigation 2: ***Conducting Surveys***

For Problem 2.1, review computation with percents with the Follow-up questions.

For more practice with problems about measures of central tendency. use ACE question #10 on pages 32 – 33.

Investigation 3: ***Random Samples***

Be sure to have plenty of Labsheets available for student use as well as 10-sided number cubes and 10-section spinners.

For Problem 3.3, line plots made from the data on page 39 are needed for ACE questions #1 and 2.

For more practice with problems about scatterplots and measures of central tendency. use ACE questions #7 - 8 on pages 44 – 45.

Investigation 4: ***Solving Real-World Problems***

The two Problems in this Investigation may require more time than the allocated pacing guide suggests.

For Problem 4.2, bring in chocolate chip cookies for students to experiment.

Clever Counting
Teaching Notes

Reflections

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"Looking Back and Looking Ahead" Unit Reflections

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Overview

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Investigation 1: *Counting Possibilities*

To find the factorial of a number using the TI-83 graphing calculator, see page 1f in the Teacher's Guide.

For more practice with problems that have students find all of the possible combinations for a given situation. use ACE questions #1 – 3, 9, and 19 on pages 9 - 13.

Investigation 2: *Opening Locks*

Students should do Problem 2.1, Follow-up 2.1 question #3, and Follow-up 2.2 question #4 if they are trying to solve the crime. The problems help students begin to analyze the information to determine the thief.

For more practice with problems that have students find all of the possible combinations for a given situation. use ACE questions #9 - 10 on page 23.

Investigation 3: *Networks*

Students may need to trace paths for additional assistance in solving the problems in this Investigation. Consider providing worksheets for students to write on or have students copy networks onto paper.

Investigation 4: ***Deciding Whether Order Is Important***

Having several sets of dominoes available in the classroom would be beneficial to students who have never used them.

Investigation 5: ***Wrapping Things Up***

Help students to apply thinking and reasoning skills to open-ended situations in which assumptions must be made. Have students create a persuasive argument to support their conjectures.

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