A HANDBOOK

INTEGRATING

CHILDREN'S LITERATURE

AND UPPER ELEMENTARY MATHEMATICS

MASTER'S PROJECT

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DEDICATION

To my daughters, Elizabeth and Elyse, for their support and understanding during this time of transition.

CHAPTER I

INTRODUCTION

Purpose of the Study

With the trend toward student-centered instruction in which the student is an active constructor and not a passive receiver of knowledge, there has been a shift in the way that reading, writing, and mathematics are viewed. They are no longer seen as ends in themselves but as learning tools (Whitin, Mills, & O'Keefe, 1994). As a result, the curriculum has become process oriented, not just fact based. Since there have been these changes, this author feels that it is reasonable to integrate these disciplines. The means for connecting them is children's literature.

Children's literature can be the starting point for investigating mathematical ideas in two areas. First, when children are analyzing the information from the literature which they are interpreting and enjoying, they are developing skills in critical thinking and mathematical reasoning. Second, through literature information, they are connecting written or oral language to mathematical language (Karp, 1994).

Furthermore, children's literature helps the students connect mathematics with everyday, authentic activities (Hoban, 1985; Hutchins, 1986). It implements the National Council of Teachers of Mathematics (NCTM) Curriculum and Evaluation Standards for Teaching Mathematics (1989) that states that mathematics is a language and that this concept is a goal for math instruction. Similarly, another goal of the NCTM that is accomplished by children's literature is to integrate mathematics with other disciplines so that students can value mathematical relationships (NCTM, 1989, p. 5). Finally,

children's literature involves the skill of problem-posing (Brown & Walter, 1983). The students can adapt what they learn from mathematical stories to related problems.

Consequently, these reasons for connecting children's literature and mathematics are related to the whole language classroom. In the whole language classroom, the activities are meaningful, purposeful, and have audience. The teacher and the student collaborate in the context and direction of the curriculum (Edelsky, Altwerger, & Flores, 1990). Thus the classroom is student-centered. It is in this context that this author planned to pursue the project.

Problem Statement

The purpose of this study was to assemble a handbook to assist upper elementary teachers in integrating children's literature and mathematics.

Procedures

This handbook was assembled by the author after she served on the committee to upgrade the Clark County Schools' Mathematics Course of Study. Since the author is a teacher and familiar with the Ohio Model, the handbook is based on this program. Furthermore, the Ohio Department of Education's Model Competency-Based Mathematics Program reflects the NCTM Standards. It is another structure of the NCTM Standards personalized for Ohio teachers. However, the committee suggested activities for each strand but did not include literature as means to enhance mathematical concepts.

This author feels that this idea would be important to research. This completed handbook will be included with each course of study delivered to all the upper elementary teachers in Clark County Ohio.

Consequently, this author took the NCTM Standards-based Ohio Model and located three pieces of children's literature for each of the eight strands. Activities were then suggested for each of the books. The activities were selected to interest the upper elementary student, to foster hands-on participation, to be teacher friendly in terms of expense and time as well as to augment mathematical concepts.

Assumptions and Limitations

The author of this handbook believes that it will be helpful to upper elementary teachers by providing them with a means of integrating children's literature and mathematics. The literature is simple and interesting. Furthermore, even though it is written with the upper elementary curriculum as its basis, it will be useful to most primary teachers by providing them with a variety of activities. The contents can be beneficial to them as it supplements more traditional methods of teaching mathematical concepts. By using information that is authentic and meaningful, the students become involved in the process.

The literature and activities listed in the handbook are appropriate to all students no matter the gender, economic, social, or geographic conditions of the students, teachers, or schools. Additionally, it is assumed that the teacher will orally read the literature to the students. This method will prevent reading problems and allow the

students to focus on the literature and the connection to the corresponding mathematical concepts.

Since the handbook addresses all areas of the NCTM Standards, it covers the whole academic year. There are three books and activities for each of the eight strands. The teacher has the option of using one, two, or three books. Each book is independent of the other. With the multitude of new, excellent children's literature published each year, an update may be needed periodically. The author of this handbook believes that it is a student-centered learning tool that includes authentic, real-life experiences with children's literature while implementing the NCTM Standards in a teacher-friendly form.

Definition of Terms

Whole Language. Whole language is the philosophy that literary skills and strategies are developed in the context of whole, authentic literary events, while reading and writing experiences permeate the whole curriculum; and learning within the classroom is integrated with the life of the whole child (Fox, 1993).

Integration. Integration is using the language components of reading, writing, speaking, and listening in all areas of the curriculum. It is a process that involves an unified core of concepts and activities (IRA/NCTE Standards, 1996).

CHAPTER II

REVIEW OF LITERATURE

Mathematics Education

With the recent publication of two major documents, the direction of mathematics education in the United States is changing. The National Council of Teachers of Mathematics (NCTM) Curriculum and Evaluations Standards for School Mathematics (1989) and Professional Standards for Teaching Mathematics (1991) have recommended that the goals for students must reflect the importance of mathematical literacy. The five general goals are: 1) that they learn to value mathematics, 2) that they become confident in their abilities to do mathematics, 3) that they become mathematical problem-solvers, 4) that they learn to communicate mathematically, and 5) that they learn to reason mathematically. These goals imply that the students be exposed to numerous and varied interrelated experiences that are involved with everyday, authentic situations (NCTM 1989, p. 5).

Furthermore, these goals must include 1) that the students are actively involved in doing mathematics, 2) regarding mathematics as thinking and making sense, 3) powerful but changing, mathematical content, and 4) the belief that all students can learn and appreciate mathematics (Lappan, 1993, p. 524). Several states have written these goals into their curricula to reflect NCTM Standards (Willis, 1992). Ohio is well on the way to accomplishing the new mathematics guidelines. The National Council of Teachers of Mathematics has worked closely with the Ohio Department of Education to formulate an

extensive model for statewide mathematics. This Ohio Model is divided into eight strands.

These ideas concerning mathematics reflect the 1960's thinking of Jerome Bruner (Post, 1988 p. 12). He stressed the importance of the enactive level of learning. Enactive learning addresses hands-on or direct experience. Textbooks alone do not produce direct interaction with the environment. Unless textbooks are supplemented with real-world experiences, there is an enactive void.

Consequently, NCTM Standards allow mathematics to move from students not learning to think mathematically or to see mathematics in all their life experiences toward a holistic problem-solving focus (Whitin, 1992, p. xii).

This holistic approach has lead to whole concept mathematics. Brown (1991, p. 160) describes whole concept mathematics as an approach that emphasizes problem-solving situations that are real and significant, enabling students to master what they have learned. The connections and relevancy become obvious to everyone.

In comparison to the NCTM Standards, the whole concept approach contains many similarities. They both emphasize the meaningful use of mathematics, the conceptual idea of learning, the verbal and written communication of mathematics, the integration of disciplines, and the utilization of real-life situations and problem-solving. The learner-centered approach is vital to both as well (Brown, 1991, p. 163). They promote the view of a learner who constructs meaning and advocate using real-life problems with more than one right answer (Math Assessment, 1991).

The benefits to the student are that they are involved, interested, actually use mathematics, and understand the practicality of what they are studying. Since they are applying mathematics, they are retaining it. They are "involved learners, not bored recipients" (Brown, 1991, p. 163). Moreover, these are the same visions of the NCTM. Mathematics is something one does - solve problems, communicate, reason. The curriculum is for all and includes a broad range of content, a variety of contexts, and deliberate connections. The learning of mathematics is an active, constructive process. The instruction is based on real problems (NCTM Standards, 1989, p. 255).

In summary, there is a new holistic approach in mathematics education. The NCTM Standards has had a revolutionary affect. Mathematics is viewed as problem-solving in authentic, everyday experiences.

In the above section, the author discussed the current standards in mathematics. In the following section, the author discusses the principles of whole language.

Principles of Whole Language

Whole language is a philosophy of learning and teaching. It is based on a number of fundamental assumptions. Learning is social, requires risk-taking and experimentation, and involves constructing meaning. It also involves relating new concepts with past experiences. It involves the teacher and the student working together in the learning process (Newman & Church, 1990, p. 26).

Eminent researchers and authors involved in this learning philosophy include Kenneth Goodman (1986), Reggie Routman (1988, 1991), Mem Fox (1993), and Lucy Calkins (1994). They view education as a learning process that is taking place through experiences. It is student-centered instruction in which the teacher is the leader of the social group. She is the director not the dictator, and she provides the freedom for the student to experience and grow through inquiry (Routman, 1991, p. 24). The relationship between the teacher and the student is one of mutual trust and respect. The teacher needs to have knowledge not only of the material but also and more importantly, the student (Fox, 1993, p. 59). She must have empathy for and understanding of the student in order to develop rapport. The teacher recognizes the dignity and inherent worth of each student as well as the fact that all children have different abilities, interests, and needs. The teacher knows that it is important to incorporate writing into all areas of the curriculum (Calkins, 1994, p. 498). The writing must be authentic, meaningful, purposeful, and have an audience (Goodman, 1986, p. 9). The students have ownership of the topic and writing (Atwell, 1987, p. 95). Furthermore, the students need an environment that is safe and supportive. In this whole language approach, the student is actively involved in successful experiences so the learning is achieved through whole concepts not isolated parts.

At the 1990 Inter-TAC Institute on Curriculum and Instruction in Washington, D.C., many facets of the whole language philosophy were discussed. They were divided into the areas of whole language philosophy, facts, and learning outcomes. Whole language is derived from observations of children's natural use of language. It is a

literacy program that builds on existing learning and utilizes intrinsic motivation. It is reading and writing strategies that are formed during functional, meaningful, and relevant language use. Whole language teachers create an environment and invite learners to participate in and plan literary events and learning opportunities. The materials for instruction must be whole texts that are meaningful and relevant. Finally, risk-taking is essential for the student to progress (Milz, 1990, p. 165).

Moreover, the facts of whole language include that the students have choices and teachers participate as well as facilitate. The instruction is informal and discovery-based. There is the use of much modeling and mini-lessons. Comprehension of meaning is the goal of the learning while the student is immersed in language (Milz, 1990, p.166).

Finally, whole language learning is authentic, natural, and functional. It is contextualized and integrated. It is empowering for the students who take ownership of their work. It is personal and involved in a social community environment. Whole language is indivisible and holistic (Milz, 1990. p.167).

In the above section the author discussed the principles of whole language. In the following section, the author discusses the topic of integration of the curriculum.

Integrated Curriculum

From recent research, it has been discovered that the brain searches for patterns and interconnections as its way of constructing meaning. If people learn by making

connections, then it is reasonable to teach through connections (Caine & Caine, 1991, p. 3).

Still, today, many students move from class to class where they are taught subjects in fragmented, disconnected ways that have little resemblance to real life. There is no connection to everyday experience or other subject content (Drake, 1993, p. 2).

In fact, as early as the 1920's, the progressive movement in education advocated curricular integration through themes. They believed that the disciplines prevented students from seeing relationships between subjects. This lack of connection resulted in a decrease in the content's relevance (Eisner, 1992, p. 29). The idea of themes is not new, but it is an idea that needs more implementation.

Consequently, the implementation of connecting subjects through themes is called integration. As Drake (1993) states:

> Integration connects subject areas in ways that reflect the real world. When we set the curriculum in the context of human experience, it begins to assume a new relevance. Higher-order thinking skills become a necessity as students begin to grapple with real issues and problems that transcend the boundaries of disciplines.

The integrated curriculum is also an aid in the retention of knowledge. Integration is a means for students to organize knowledge before attempting to remember it. By understanding how it all fits together, connecting new knowledge with old, and acknowledging connections and interrelationship, the students now have a vehicle for the memory process (Brown, 1991, p. 160).

However, the integration of the mathematics curriculum has not been accomplished to any great extent. The student was expected but never instructed to

integrate the separately taught skills. With the concept of whole math, there is the opportunity to increase its use. In-depth study is consistent with theme or problem solving methods and this curriculum allows for an extensive study of concepts (Brown, 1991, p. 161).

Moreover, Post (1988) makes this reflection that sums up the relationship between mathematics and the integrated curriculum:

> It is time that the nation's schools involve students in a new and different type of learning environment that permits flexibility and active student involvement, contains a plethora of manipulative and other learning aids, and considers a much broader spectrum of topical areas.

However, in order to integrate the mathematics curriculum, it is necessary to decide the appropriate method for implementation. Fogarity (1991) has developed many approaches. Among them are shared, threaded, or integrated. The integrated model is "an interdisciplinary approach that matches subjects for overlaps in topics and concepts" (p. 75). This type of integration sifts ideas out of subject matter content and merges them. The learner is led to the interconnectedness and interrelationships among various disciplines.

In summary, since the brain looks for patterns and connections for meaning, the student needs to shown the same through school experiences. By means of integrating the curriculum, the student can have these experiences.

In the above section, the author discussed the role of the integrated curriculum in today's schools. In the following section, the author discusses the integration of children's literature and mathematics.

Children's Literature and Mathematics

The NCTM Standards suggests that an appropriate curriculum reflect the relationship between children and mathematics. The exploration of mathematical ideas should retain the students' enjoyment of and curiosity about mathematics. Furthermore, it should incorporate real-world contexts, children's experiences, and children's language in developing ideas.

With these ideas as a basis, it is reasonable to use children's literature as the vehicle to reach these goals. Goodman believes that the use of literature is helpful in moving toward the NCTM Standards (Whitin, 1992, xii).

It is teaching to the children's experiences and language that aid in the learning of mathematical concepts. Tischler states " to nurture the disposition to learn in mathematics, children should experience mathematics as being accessible, real, natural, thought provoking, and interesting. Children's books naturally do this" (p. 45). Hatfield believes that it is important to "incorporate mathematics into other curricular areas to form math connections. Integrate math into language arts" (p. 36). In this way, students see that mathematics occurs in many dimensions of living. It is necessary to connect topics within the areas of math so students do not view them in isolation.

Consequently, in teaching mathematics, the teacher needs to look at the world through the children's eyes. Young students learn concepts and relationships through concrete experiences rather than through mental manipulation of abstract ideas (Furth, 1970, Copeland, 1978). Many of these experiences are learned through children's literature.

Using children's literature in the mathematics program has been advocated by researchers such as Harsh 1987, Ohanian 1989, Richardson & Monroe 1989, Tischler 1988 (Young, p. 38). However, this author feels that is a need to see how children's literature is used in the classroom.

This approach of using children's literature and mathematics was accomplished in 1993 at the Little Red Schoolhouse in Manhattan, New York. The teachers , Diana Cohn and Sara J. Wendt, reconstructed the math program so that students would learn mathematical concepts in real and meaningful contexts like integrated reading and writing. The children wrote their own math problems from real-life experiences or events described in children's literature. The teachers state that " modeling mathematical concepts by means of examples from favorite books immediately attracted our students' attention and enlivened math class" (Cullinan, p. 58). They also found that problems based on children's literature were more popular than traditional book-type problems because the stories provide a meaningful, shared reference point and increases motivation to solve the problem (Cullinan, p. 66).

Another example of using children's literature was done with the topic of graphing. Using books in this problem-solving situation was the stepping stone and building block for other graphing activities. Grummer found that "through extensive discussion and hands-on experiences, students were able to apply their knowledge and make in-depth analyses of the situation with graphs" (Grummer p. 179).

Furthermore, many of the reading strategies that work in the content areas of social studies and science may also be effective in reading mathematics. Just as language

plays an integral role in the processing of concepts, it also plays a role in mathematics. If the strategies that integrate literature and mathematical skills are used, the students' abilities to function as independent problem solvers increase (Braselton, p. 280).

Additionally, the link of learning mathematical concepts to contexts that are meaningful is motivational. Literature illustrates to the student that math does not have to be learned in isolation from other subjects. It allows them to engage in mathematical problem-solving in a setting to which they can relate. "As a result of making connections between mathematics and literature, students can view math as not merely a subject to be learned but also as a natural part of everyday life" (Raymond, p. 73).

Children's literature increases students' reasoning sense and builds their mathematical thinking power. "Children's literature can be used to create activities that foster children's thinking. Additionally, it establishes a nonthreatening community where ideas are shared and thinking is encouraged. After all, the essence of good teaching is getting children to think" (Schneider, p. 552).

Consequently, educators are striving to approach learning as a whole, and literature is seen as an integral part of this whole. Students learn best when they are personally involved with the material, engaged in the topic, and have a context and framework for understanding the facts. (Roslyn, p. 24). Moreover, using children's literature as a springboard for mathematical experiences allows language and math learning to grow together naturally and imaginatively (Baratta - Lorton, p. 286).

Finally, there is much literature about the direct use of children's literature and mathematics. Tischler (1988, p. 42) found that "the mathematics curriculum for children

can grow from children's literature and as a result offer more depth and breadth". Among the reasons for this augmentation is that children's literature gives more real experiences than curricular guides or texts currently suggest, builds on children's interest, and involves them in an informal, active, creative way.

Harsh (1987, p. 24) discovered "that books are not often used to launch interesting math activities. Since books are in every good program and we want to help children to learn and enjoy math concepts, we should not waste this excellent resource". Furthermore, she believes that books connect the abstract and concrete.

Consequently, Goodman (Whitin, 1992, p. xi) states that "fiction and nonfiction provide rich, authentic explorations of time and place and human experiences that make the math concepts children are exploring vivid, relevant, and involving". This statement is certainly an endorsement for the integration of children's literature and mathematics.

In the previous four sections, there are literature reviews that justified the need to create a handbook that integrates children's literature and mathematics. This author addressed the current national mathematics standards developed by the NCTM as well as the principles of whole language and the integrated curriculum. Finally, the appropriateness of integrating children's literature and mathematics was reviewed.

CHAPTER III

A HANDBOOK
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AND UPPER ELEMENTARY MATHEMATICS

by

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Introduction

With the trend toward student-centered instruction in which the student is an active constructor and not a passive receiver of knowledge, there has been a shift in the way that reading and mathematics are viewed. They are no longer seen as ends in themselves but as learning tools. Since there have been these changes, I feel that is reasonable to integrate these disciplines by means of children's literature. Furthermore, many current textbooks contain student-directed activities, but there is still a need to extend the use of literature sources to supplement the text. The children's literature can be obtained at public libraries. Using children's literature with mathematics results in activities that are meaningful, purposeful, and have audience.

The literature and activities are of a nature that appeals to all learning styles and ages. The literature is interesting, multicultural, and meaningful. The illustrations are attractive and pleasant. The activities are varied and do not require many additional supplies.

Consequently, the intent of this handbook is to be a useful, vital resource for the teachers of upper primary classrooms. As a result, the students will participate in meaningful, enjoyable math related activities. The areas of mathematical concepts were adopted from the Ohio Department of Education's Model Competency- Based Mathematics Program which supports the Standards established by the National Council of Teachers of Mathematics.

Dear Upper Elementary Teachers:

I have compiled this handbook of children's literature and mathematical activities as a classroom resource. It is patterned after the Ohio Model Competency-Based Mathematics Program which implements the National Council of Teachers of Mathematics Standards. The handbook is divided into eight strands. They are:

STRAND 1 PATTERNS, RELATIONS, AND FUNCTIONS

STRAND 2 PROBLEM-SOLVING STRATEGIES

STRAND 3 NUMBERS AND NUMBER RELATIONS

STRAND 4 GEOMETRY

STRAND 5 ALGEBRA

STRAND 6 MEASUREMENT

STRAND 7 ESTIMATION AND MENTAL COMPUTATIONS

STRAND 8 DATA ANALYSIS AND PROBABILITY.

In each strand, there are three books listed. Each book has activities suggested to implement the mathematical concept. I hope that you will find this handbook to be a useful and vital resource for you and an enjoyable and meaningful experience for your students.

Sincerely yours,

Elaine Bennett

from the Ohio Model Competency-Based Mathematics Program:

STRAND 1: PATTERNS, RELATIONS, AND FUNCTIONS

This strand enables students to see and explore regularities in the world about them by providing a set of experiences that are appropriate to the developmental stages of students. In the beginning, shapes and numbers, patterns and designs from different cultures, and changes in the rhythm and pitch of music are explored. The objectives are written in such a way that any kind of pattern observable in the environment is appropriate for investigation.

The study of patterns merges into the study of relationships. The focus becomes building mathematical models that will predict behaviors which have an exhibited pattern that students have recognized and described mathematically.

Model Competency-Based Mathematics Program. Ohio Department of Education, 1990, November. p. 15.

STRAND 1: PATTERNS, RELATIONS, & FUNCTIONS

Bayou Lullaby (1995)
by Kathi Appelt
illustrated by Neil Waldman

Summary: A girl is sung to sleep by the words of her mother's lullaby. This is the story of the starry nights in the Bayou. It is written in the rhythms of Cajun speech.

Activities:

1. Read the book entirely through the first time.

2. Reread the book pausing to find the pattern in each verse. Use colored blocks to demonstrate the rhyme patterns.

3. Pick one of the creatures mentioned in the story-crickets, herons, bullfrogs, crawdids. Research to see the life cycle or patterns in their lives.

4. Draw a picture to illustrate the poem and print a verse to accompany it.

5. Using a hundreds chart and beans, explore the patterns that result from using various rules. For example, take off all the numbers with 2 in them. Take off all the numbers that are multiples of 3. As a result of studying the patterns, the students will have a sense that mathematics fits together.

STRAND 1: PATTERNS, RELATIONS, & FUNCTIONS

Sea Witches (1991)
by Joanne Robertson
illustrated by Laszlo Gal

Summary: This story about a Scottish superstition is told in haiku. The superstition is that sea witches use whole eggshells to make boats and terrorize sailors. Consequently, the little boy in the story must remember to crush his eggshells.

Activities:

1. Read the book entirely through the first time.

2. Have students identify the pattern of haiku. It is always three lines of five, seven, and five syllables respectively. Use the pattern and write their own verse.

3. Using examples of limericks, have students identify the patterns. Use the pattern to write their own verses.

4. Connect the idea of patterns to numbers by calculating the following numbers:
0x9+1=
1x9+2=
12x9+3=
123x9+4=
What are the patterns?
Why do they happen?

5. With a partner, make up number pattern problems to share with others. For example, add or subtract the same constant to each term. Have the partner identify the pattern.

6. Ask the students to discover if there is a pattern when two even numbers are added or multiplied. Experiment with several examples using counters.

7. Ask the students to discover if there is a pattern when two odd numbers are added or multiplied. Experiment with several examples using grid paper.

8. With centicubes, count four cubes and form a square. Then have them find another number of cubes that will form a square. What is that number? Discover the first five square numbers and list them.

STRAND 1: PATTERNS, RELATIONS, & FUNCTIONS

Sweet Clara and the Freedom Quilt (1993)
by Deborah Hopkinson
illustrated by James Ransome

Summary: This story relates how a quilt is used to guide young slaves to freedom. It tells how pieces of material can be put together to form a map. This is also an excellent story to integrate with Ohio history and the Underground Railroad.

Activities:

1. Read the book entirely through the first time.

2. Students will draw a square of material to represent an outgrown piece of clothing. These pieces will be glued together to make a class quilt.

3. Using parquetry blocks, have students experiment with them to form a pattern. Copy the design since quilts are based on patterns and compile a class book.

4. Using tangrams and construction paper, make repeated patterns on narrow strips to use as a bulletin board border.

5. With a partner, make a pattern on a geoboard. Have the partner copy it on another board. Reverse roles.

6. Create a visual pattern with colored beads. Have students string beads and the partner will copy the pattern. Also the teacher will describe a pattern for the students to copy.

from the Ohio Model Competency-Based Mathematics Program:

STRAND 2: PROBLEM-SOLVING STRATEGIES

The purpose of mathematics is to solve problems, and this activity must permeate all the strands of mathematics. The strand provides an organized introduction of problem-solving techniques or strategies. It must rely on other strands for the content addressed by these strategies. Problem solving can be a powerful connecting link between strands.

Students should be required to explain and validate their process of solution. Among other skills, they should be able to describe false starts and their reasons for starting over. Ideas need to be effectively communicated by words (oral and written), diagrams, pictures, actions, mathematical symbols, or any other appropriate method. Evaluation of problem solving in the school environment should focus on the process as well as the solution.

Leaders in industry remind us that their problem situations many times can be solved only by teams of responsible employees rather than individuals. We must provide an opportunity for students to simulate this process by having them work together to determine solutions, and then contrasting and comparing solutions with those developed by other teams.

Model Competency-Based Mathematics Program. Ohio Department of Education, 1990, November. p. 24.

STRAND 2: PROBLEM-SOLVING STRATEGIES

Jumanji (1981)
by Chris Van Allsburg

Summary: Two children are playing the board game Jumanji when the events in each square become real. When someone finally wins the game, everything returns to normal.

Activities:

1. Read the book entirely through the first time.

2. Given a blank game board sheet, the students in small groups design their own new game in which they use wild animals and natural disasters in the United States. The problem-solving involved includes what kind of game to make, how someone would win, and how the board would look. Write out the rules and build the game. Exchange games and play.

3. Having a jar with river rocks labeled "River Rocks from Jungle", brainstorm ways to estimate the number in the jar. Use two of the methods to find the closest estimate.

4. Using the artwork from the book, identify the different patterns found in all the pictures. Through a class discussions, develop definitions for the words "pattern" and "design." The students will design a pattern to use on the game board.

5. The clocks in the book use Roman numerals. Write the numbers from 1-9. Create addition and subtraction problems. Exchange. Brainstorm other places in everyday situations where Roman numerals are used.

6. The Jumanji board has 48 spaces and it is played with one die. With a partner, calculate how many rolls it would take if the same number appeared every time. What problem-solving strategies can you use? Solve the problem. What would happen if another number was used? Try 2, 3, 4, 5.

STRAND 2: PROBLEM-SOLVING STRATEGIES

The King's Chessboard (1988)
by David Birch
illustrated by Devis Grebu

Summary: A wise man is commanded by the king to choose a reward. Although the man does not want anything, he reluctantly decides on a grain of rice doubled daily until the chessboard is filled. The wise man shows that pride can make a fool of anyone.

Activities:

1. Read the book entirely through the first time.

2. One method of problem-solving is to act out the situation. On the first day, put one grain of rice in a jar. On the next day, double the amount which is two and put in the jar. Put in four grains the next and eight grains the next. The number is always doubled. After ten days, what is the number of grains? How many should there be in 20 or 30 days? Students will illustrate the results.

3. The chessboard is like a grid. Students with a partner will take turns giving points on the grid to make four in a row. What strategies must each person use in order to win?

4. Using a 3x6 grid, partners take turns putting grains of rice on one or two squares at a time. If two squares are covered, they must be fully connected. No one can skip a turn. The person to fill the last square or squares wins. What strategies need to be used?

5. A Venn Diagram is a problem-solving tool. Students will compare the two men in the story. Then they will construct a Venn Diagram and choose characteristics that some friends will have and some will not. The friends will sign their name in the appropriate circle. Record the results and share.

6. Create a recipe for rice pudding using instant pudding, milk, cooked rice, and cinnamon. What strategies could be used to determine the total price of the pudding? Students explain their choices. Decide if the recipe needs to be doubled or tripled to feed the entire class. Collect data and construct a table to share information.

STRAND 2: PROBLEM-SOLVING STRATEGIES

The Math Whiz (1990)
by Betsy Duffey
illustrated by Janet Wilson

Summary: Marty Malone is great at math, but finds out that he needs more than just math to be happy. He has other problems in third grade. The problems are physical education and making friends.

Activities:

1. Read the book entirely through the first time.

2. One of the Math Whiz's problems is picking teams. Students will explain in written and oral form their problem-solving strategies for making computations in multiplication and division to determine teams. Students will be given several numbers from which to determine teams.

3. Using M & M's, students will divide them evenly among small groups. List the problem-solving strategies that they know. Select the appropriate strategy and explain the procedure.

4. Math Whiz has a snack after school. He and his new friend have 27 cookies to share. Brainstorm the methods they could use to divide the cookies between them. Before they can eat them, two more friends arrive. Then two more arrive. Explain and justify the solution in writing. Determining how to best record and report is an important problem-solving challenge.

5. At the Math Club picnic, there were twelve students. Glue macaroni on a page to illustrate different ways to make the number twelve the answer to number sentences. What are the different strategies used to accomplish this?

from the Ohio Model Competency-Based Mathematics Program:

STRAND 3: NUMBERS AND NUMBER RELATIONS

This strand encompasses the whole of students' formal experiences with number . It includes the development of number sense, of understanding of and skill at computation with numbers of all kinds, and explorations of certain aspects of number theory. This formal experience with numbers needs to be related to the informal, out-of-school number experiences of students.

This is an important part, but not the whole, of the mathematics curriculum. The objectives of this strand should be carefully correlated with, as well as used in, other strands such as problem-solving, estimation and mental computation, and measurement. These objectives are the workhorses of mathematics.

It is the purpose of this strand to help children develop number sense, an understanding of computation as well as skill, and a recognition of the pervasive influence of number in all of our lives. This cannot be achieved with an approach to teaching that is mainly drill and practice, nor can it be achieved if children cannot rapidly and accurately work with numbers. There must be a balance between skill and understanding and a freedom to use innovative methods.

Model Competence-Based Mathematics Program. Ohio Department of Education, 1990, November. p. 37.

STRAND 3: NUMBER & NUMBER RELATIONS

Eating Fractions (1991)
by Bruce McMillan

Summary: This is the story about a tasty meal that is shared by two friends and their dog. This book includes the introduction of fractional parts.

Activities:

1. Read the book entirely through the first time.

2. Use the recipes included in the story to motivate the students to learn how fractions are a part of their everyday life. The pizza pie could also be a lunch experiment.

3. Give an apple which has been divided into 5 unequal parts to each group of five students. Have them discuss how to give each student a piece of apple and make sure that everyone is happy with the parts. Did everyone get an equal piece or 1/5 of the apple or did they just get one piece out of five? Discover the difference between parts and equal parts.

4. Give each group a Hershey bar to divide equally. Name the parts.

5. Construct paper pumpkin pie fractions. Use brown paper for crust, orange paper for filling, and white pompoms for whipped cream. Each student will decide into what fractional pieces she will cut her pie. Use the cut pieces to compare fractions.

6. Make a "Fraction Action" display. Using pattern blocks, students trace and color several blocks. Then they write statements about their work. For example, 2/3 of the shapes are striped.

7. Play "Fraction Dice" game. Roll die two times. The first number is the numerator. The second number is the denominator. Compare the fractions in lowest terms. Largest fraction wins.

8. Using Cuisenaire rods, make comparisons. The orange equals one whole and the others are fractional parts. For example, 10 white pieces equal one orange so each white is one-tenth. Write statements relating to results.

STRAND 3: NUMBER & NUMBER RELATIONS

The Million-Dollar Bear (1995)
by William Kotzwinkle
illustrated by David Catrow

Summary: A valuable, antique bear is kept away from life. He escapes and finds adventure and happiness with a new family. There is much truth about living portrayed in this story.

Activities:

1. Read the book entirely through the first time.

2. List everyday uses of large numbers. For example, large numbers are used in car prices, house ads, and outer space.

3. With a partner, students use a 0-9 spinner and a place value chart. Make a large number by spinning 5 times and mark the numbers on the chart. The partner gives the value of each digit.

4. With spinners and individual place value charts, students in small groups put numbers on the charts. After 7 spins, students decide who has the greatest number and who has the least number.

5. Four students stand in front of the class and each holds up fingers to show a digit (1-9). Record the numbers on the board. Arrange the digits in as many 3-digit numbers as possible. Order these numbers. Repeat using more students and digits.

6. Research a planet. Practice reading the large numbers with a partner.

7. Play "What's My Place?" Using randomly placed 6-digit numbers on the board, pick a number and name its place. Then give a place value to a partner and the partner names its digit. Reverse places.

8. Use calculators to explore expanded notation. For example, enter 3,216 and subtract 3,000, leaving 216 - 200 = 16, - 10 = 6.

STRAND 3: NUMBER & NUMBER RELATIONS

One Hundred Hungry Ants (1993)
by Elinor J. Pinczes
illustrated by Bonnie Mackain

Summary; One hundred hungry ants head towards a picnic where there is delicious food to eat. However, they stop to change their line formation, showing the different arrays for 100, which causes them to lose both time and food in the end.

Activities:

1. Read the story entirely through the first time.

2. Reread the story and have the students list the different factors for 100 that are shown in the book.

3. Gather different muffin tins to demonstrate the concept of arrays. Divide the students into small groups. Students determine a multiplication and division problem that their muffin tin represents. Fill the tins with batter. While muffins are baking, students share array-related problems. Students then find and list other classroom arrays such as windowpanes and desk arrangements.

4. Play "Macaroni Arrays". Given a product, the student will use macaroni to demonstrate as many different arrays as possible to illustrate that product.

5. Play "Shake and Take". Students use two marbles in a randomly numbered egg carton with digits from 1-9. After shaking the egg carton, they multiply the two digits where the marbles have landed.

6. Given a spinner with sections 1-9, the students will spin twice, then use those two digits to form a "Fact Family" for multiplication and division.

from the Ohio Model Competency-Based Mathematics Program:

STRAND 4: GEOMETRY

Geometry is an important component of the mathematics curriculum at every level. It helps in exploring, describing, and understanding the world in which we live. This strand includes objectives that require students to investigate, experiment, and explore with physical materials, drawings, and computers. Students also communicate the results of their investigations with verbal descriptions or drawings. The K-8 part of the strand is designed to help children develop spatial sense and develop facility with the language of geometry before the more formal study of geometry takes place at the secondary level. Something more than a superficial study of geometric shapes and terminology is essential from the earliest school experience.

The strand begins with recognition of whole shapes in the classroom and the environment and proceeds through analysis of the properties of shapes and their transformations to the expression of geometric properties algebraically. While informal proof or validation is used in the early grades, more formal proof is delayed until the high school grades.

Model Competency-Based Mathematics Program. Ohio Department of Education, 1990, November. p. 51.

STRAND 4: GEOMETRY

Albert's Alphabet (1991)
by Leslie Tryon

Summary: Clever Albert uses all the supplies in his workshop to build an alphabet for the school playground.. He uses many different materials to complete his project.

Activities:

1. Read the book entirely through the first time.

2. Think of the capital letters of the alphabet. Pick one, for example C, and write it backwards. Compare to see if it looks like the original. Do the experiment with another letter. Try letter A. It looks the same because it is symmetrical. List all symmetrical letters and nonsymmetrical letters on a chart.

3. Make "Blob Pictures". Fold a paper in half. Open it and put a blob of paint on one side. Fold it in half again and press. Open it to see what design has been made.

4. Make "Cut Outs". Fold a paper in half. Cut a shape along the fold. Guess what the shape will look like when the paper is opened. Paste the paper on another sheet to display.

5. Cut several shapes out of the edge of paper. Paste this sheet on a sheet twice as large. Fit the cut out pieces into the original holes. Flip them to the opposite side and paste. The result is a reverse design.

6. Draw the ABC's. Use a mirror and cover up part of the letter. Determine if the whole letter can still be seen. List letters that will work. Try words such as WOW. List other words that will fit the pattern.

7. Discover any objects in the classroom and home that are symmetrical. Draw them and make a display.

STRAND 4: GEOMETRY

Changes, Changes (1971)
by Pat Hutchins

Summary: A wooden man and woman adapt a set of blocks to suit their needs through a series of changes. They start with a house and change to a fire engine, boat, truck, and finally back to a house.

Activities:

1. Read the book entirely through the first time.

2. With a set of Lego blocks and a partner, the students will make up their own story modeled after Changes, Changes. They will use the same set of blocks to construct a sequence of scenes. The stories will then be shared.

3. Distribute a geometric solid to each group. List as many things as possible in everyday life that contain this shape. Exchange solids. When all of the solids have been examined, compare answers.

4. Make edible play dough of 2 1/4 cups of peanut butter, 6 tablespoons of honey, and nonfat dry milk to make play dough consistency. Use this material to model various geometric solids. With the solids, create a figure. Eat when finished.

5. In cooperative groups, have students construct two- and three-dimensional geometric shapes out of plastic straws and string. Then with a soap bubble solution, the students will create non-spherical three-dimensional bubbles.

6. With sugar cubes, build a small cube. Record the number of cubes used. Build the next larger cube. Record the amount needed. Continue building and recording. Discover the pattern.

7. With pipe cleaners, construct two- and three-dimensional shapes. Using these shapes, make a mobile to display in the classroom.

STRAND 4: GEOMETRY

The Greedy Triangle (1994)
by Marilyn Burns
illustrated by Gordon Silveria

Summary: A triangle is unhappy with his shape and doing the same activities everyday. He asks to be changed into other shapes and has adventures in each resulting form.

Activities:

1. Read the book entirely through the first time.

2. Design a border for the bulletin board which incorporates several polygons in a repeated pattern. Use different colored construction paper for each polygon. Even though the students use different shapes, the border looks connected.

3. List additional places where shapes are seen in everyday life. Compile a big book with illustrations.

4. Students choose one large polygon. Paste the shape on a sheet of paper. Incorporate this shape into a picture.

5. Using pretzel sticks, make various polygons. Record the shape, name, number of sides, and number of angles.

6. Using five 2-inch squares, discover how many of the 12 possible arrangements you can find in which the entire edges are always touching. Draw the arrangements on graph paper. Fold the cut out shapes to determine if any of them will form a box.

7. With six strips of paper and five paper fasteners, make an angle maker. Use the angle maker to illustrate various shapes.

8. With four toothpicks form a square. Draw and record the number of toothpicks. Then make four adjacent squares. Draw and record this amount of toothpicks. Then repeat activity using 20 toothpicks. Experiment with larger amounts of toothpicks and discern the pattern.

from the Ohio Model Competency-Based Mathematics Program:

STRAND 5: ALGEBRA

All students need algebra. Algebra is critical to success in school mathematics for two primary reasons:

1. Algebraic thinking serves to consolidate arithmetic skills and understandings.
2. Algebraic thinking equips students with the capability to succeed in mathematics beyond elementary school.

Algebraic thinking is a component of most mathematics used beyond secondary school.

Success in algebra is too important to be left until middle or secondary school experiences. Patterns of thinking must be introduced in intuitively familiar numerical settings before children encounter their first formal course in algebra. Students should build basic algebraic ideas and skills by making generalizations about numerical problem situations.

This strand provides a developmentally sensible approach that features use of variables in describing dependency relationships, highlights attention to graphs and their interpretations, and promotes key ideas from a base of problem-solving experiences. A focus on moving among different representations of algebraic ideas establishes a base for featuring communication and connections in the classroom as well as providing for a sounder approach to learning.

Students are expected to learn how to use the technology of modern industry and of learning institutions beyond the secondary level. Calculators with algebraic operating systems should be introduced early. It should be remembered that the curriculum works better if students have access to graphing calculators and computers for secondary school mathematics. The use of technology provides for more efficient and better learning of algebraic concepts in addition to building necessary skills and understandings for life beyond school.

Model Competency-Based Mathematics Program. Ohio Department of Education, 1990, November. p. 63.

STRAND 5: ALGEBRA

A Grain of Rice (1986)
by Helena Clare Pittman

Summary: After a peasant saves the life of the Princess, the Emperor gladly offers the peasant any reward he chooses except the Princess. Pong Lo requests a single grain of rice, doubled every day for one hundred days. Pong Lo turns out to be a very clever fellow.

Activities:

1. Read the book entirely through the first time.

2. The Emperor's mathematician used an abacus to figure the amount of grain that Pong Lo received as the days went by. The abacus is a type of calculator that the Chinese use. Demonstrate how an abacus works. Using copies of an abacus, practice adding and subtracting by shading the appropriate beads.

3. Illustrate the containers and corresponding amounts of rice given to Pong Lo on the first through the eighth days. Write algebraic number sentences to accompany each one.

4. If a teaspoon holds about 170 grains of rice, about how many bushels of rice will there be on the thirtieth day? Figure it out by starting with the concept of 3 teaspoons equals one tablespoon equals ____grains. Then 2 tablespoons equals 1 ounce equals _____grains. Use this progression-ounces, pints, quarts, peck, bushels.

5. Figure the price of rice using a calculator. For example, if you need 2 1/2 pounds of rice at $.97 a pound, what is the total cost? Figure the cost of an ounce a rice at the same price. Have students make up problems modeled after these and challenge each other.

6. Play "Cash Codes". Using a calculator and assigning money values to letters such as a = one cent, find words that equal $1.00.

7. Demonstrate factorials. For instance 4! equals 4x3=12, 12x2=24, 24x1=24. Use calculators and explore the concept. Use everyday situations to illustrate factorials' usefulness. For example, if there are four desks and four students, how many different arrangements can be made?

8. Play "Checkbook". Enter $100.00 in calculator. Start subtracting for various items purchased. Try to reach zero.

STRAND 5: ALGEBRA

How to Make an Apple Pie and See the World (1994)
by Marjorie Priceman

Summary: A young girl who wants to make an apple pie must take a trip around the world because the stores in her town are closed. She learns much about products around the world.

Activities:

1. Read the book entirely through the first time.

2. Survey twenty people about their favorite kind of pie. Use a table to record and organize the information.

3. Make a chart to organize the information about the countries, products, and mileage the girl encounters.

4. Use the recipe in the story to make apple pie. Then plan how much of each ingredient is needed to serve twenty people. Make a chart to organize the results.

5. Play "5 in a Row". Draw a 6 by 6 grid on the board. Two teams take turns naming ordered pairs on the graph. The first team to get five points in a row on the grid is the winner. The girl in the story used a map which is a grid to travel.

6. On a 12 by 12 grid, students draw a picture such as a boat, flower, or an animal. List the ordered pairs and give them to another student who tries to recreate the picture successfully.

7. A palindrome is a number that reads the same forward and backward. Write any three-digit number. Add the reverse to it. Is it a palindrome? If it is, then it's a one step palindrome. If it isn't, add the reverse of the sum until a palindrome is formed.

STRAND 5: ALGEBRA

Math Curse (1995)
by Jon Scieszka
illustrated by Lane Smith

Summary: When the teacher tells her class that anything in their life can be a math problem, a student develops a math anxiety which results in a math curse. This is a very interesting book that shows mathematics in everyday life.

Activities:

1. Read the book entirely through the first time.

2. List all the real-life situations in which mathematics play a part. Each student will illustrate a use of math with a picture and number sentence.

3. Demonstrate a "Function Box". One number goes in the box, but comes out as another number. Figure out what happens to the number in mathematical terms. Students create function boxes to share with the class.

3. Construct paper plate clocks with moveable hands. Relate everyday situations involving cooking times. For example, if it takes 15 minutes a pound to cook a turkey, how long will a fifteen pound turkey take? If the turkey goes into the oven at noon, when will a 10 pound turkey be ready? If you want to eat at 5:00, what time should a 20 pound turkey be put in the oven?

4. From a bag of 50 beans, students will remove a handful. Count the beans. Write a number sentence to determine how many beans were still in the bag. Write an addition problem to accompany it.

5. With a deck of cards without the face cards and a partner, deal four cards to each person. The next card is the answer to the problem. Each player uses all their cards and any operations they choose to make a math problem that results in the answer.

6. Play "Three Stacks". Each student writes any number between 20 and 200 on an index card and makes a stack. The second pile has index cards with the numbers 2-9 on each. The third stack has cards with one of the four operations on them. A member from each of two teams draws one card from each stack and writes the equation on the board and solves for "n". The player with the greatest value for "n" wins a point.

from the Ohio Model Competency-Based Mathematics Program:

STRAND 6: MEASUREMENT

In establishing a firm foundation in the basic underlying concepts and skills of measurement, students need to understand the attribute to be measured as well as what it means to measure. It is recommended that students experience a variety of activities that focus on comparing objects directly, comparing them with various units, and counting the units. It is crucial that they understand the process of measuring as well as gain an awareness of the sizes of units. Decisions can be made about the sizes of objects by looking at, feeling, or comparing objects directly. These experiences provide opportunities to build appropriate vocabulary associated with measurement in a natural way rather than a contrived, artificial manner. Special attention should be given to measurements of real objects...Activities should also include everyday situations which require only an estimate.

Since students encounter measurement ideas both in and out of school, well-chosen measurement activities should provide for a dynamic interaction between students and their environment. Ideally, the study of measurement should show the usefulness and practical applications of mathematics. In addition, the students' need to communicate about various measurement activities should highlight the importance of standard units and common measurement systems. The measurement concepts that were introduced and taught in grades K-4 should be reinforced and extended in grades 5-8 . Any mathematics curriculum should focus on teaching for understanding and not overemphasize the formulas...One way students develop an understanding of measurement is to use measuring tools and to measure real-life objects. This theory supports students' working with many manipulative materials as they perform these measurement activities.

Model Competency-Based Mathematics Program. Ohio Department of Education, 1990, November. p. 77.

STRAND 6: MEASUREMENT (MONEY)

Alexander, Who Used To Be Rich Last Sunday (1978)
by Judith Viorst
illustrated by Ray Cruz

Summary: When Alexander's grandparents came to visit on Sunday, they gave him and his two brothers each a dollar. Alexander was rich, but not for long. He spent it on numerous items. In the end, all he had left was bus tokens.

Activities:

1. Read the book entirely through the first time.

2. Reread the story pausing to calculate the money left using coins or mentally. Have students explain their reasoning.

3. Have students explore how many sets of coins they can make that equal $1.00.

4. Using a newspaper, students list items that they could buy to total $1.00, $5.00, $10.00, $20.00, and $100.00.

5. Record subtraction sentences to describe Alexander's expenditures. Students use this model to illustrate their own expenditures.

6. Write a story in which the main character spends $50.00.

7. Plan a trip in Ohio and decide the cost of various expenses.

STRAND 6: MEASUREMENT (AREA & PERIMETER)

Jack's Garden (1995)
by Henry Cole

Summary: In this story, Jack plants a garden of his own. Seeds, seedlings, buds, and leaves as well as birds, bugs, and butterflies are seen in this colorful book.

Activities:

1. Read the book entirely through the first time.

2. Reread the story and discuss the tools, underground life, seeds, weather instruments, and insects shown. Have students relate their personal experiences and prior knowledge with gardening.

3. Brainstorm what is needed to plan a garden. Help students identify the size and shapes of gardens. Introduce terms *perimeter* and *area.*

4. Using geoboards, make various rectangles and calculate perimeter and area measurements.

5. Give 25 centicubes to pairs of students. The first student makes a flat rectangular figure from the centicubes. The second student estimates and then calculates the area and perimeter. Students reverse roles and discuss procedure.

6. Give the students precut rectangle papers. Cover the shapes with centicubes. Count to discover that area equals length times width.

7. Using 12 square tiles, make as many differently shaped rectangles as possible. Record the various dimensions.

8. Draw or manipulate a quadrilateral to determine length and width when given a specific perimeter.

9. Compile a big book of various rectangular shapes and label perimeter. Write a story discussing what you would plant in your garden.

STRAND 6: MEASUREMENT (LINEAR)

The Pumpkin Patch (1990)
by Elizabeth King

Summary: In this photographic essay, the activities in a pumpkin patch are described. The pink-colored seeds become fat pumpkins that are ready to be carved into jack-o`-lanterns.

Activities:

1. Read the book entirely through the first time.

2. Reread the story and discuss the sequence of events. In small groups, illustrate the story on long strips of paper.

3. Since pumpkins are part of the squash family, list other members -acorn, buttercup, butternut. Display these squash. Each student cuts a piece of string as an estimation of the circumference of each. After hands-on measuring, group string as too short, just right, or too long. Students report on accuracy. Using the strings and a ruler or meter stick, make accurate measurements.

4. Discuss other ways to measure. Estimate the length of 10 toothpicks placed end to end. Lay a pencil at your estimation. Measure with the toothpicks. Then measure with a ruler. Draw a picture to illustrate your measurement.

5. Pick out objects from the room. Decide which tool is appropriate for measuring - ruler or yardstick. Estimate lengths. Measure. Record.

6. Measure four objects from your desk to the nearest half-inch. Put objects in order from shortest to longest.

7. Estimate the length of certain body parts. Then use a string to measure. Lay string on ruler and record length to nearest half-inch.

from the Ohio Model Competency-Based Mathematics Program:

STRAND 7: ESTIMATION AND MENTAL COMPUTATION

Estimation is a skill useful in the daily life of children as well as adults. Their study of mathematics should include specific instruction in ways to estimate, when it is appropriate to estimate, and how close an estimate is reasonable. Estimates are important when determining whether the result of a computation or the answer to a problem is reasonable. Frequently, an estimate is more appropriate than an exact answer.

Estimates are important both in computation and in measurement. There is some overlap in the objectives included in this strand and in the measurement strand. A single lesson might include objectives from each of these strands.

Practice in mental computation provides children an opportunity to explore different combinations of numbers and alternative strategies for working with numbers. It is an important incentive for internalizing work with manipulatives.

A combination of estimation and mental computation helps children become more flexible in applying computation skills and better able to select a method of computation most appropriate for a given situation.

Model Competency-Based Mathematics Program. Ohio Department of Education, 1990, November. p. 89.

STRAND 7: ESTIMATION & MENTAL COMPUTATION

June 29, 1999 (1992)
by David Wiesner

Summary: While her third-grade class is planting seeds in paper cups, Holly is performing her science experiments on a much larger scale. The results of her plants are unprecedented.

Activities:

1. Read the book entirely through the first time.

2. Using the vegetables listed in the story, estimate the number of peas, grapes, and raisins in a 1/2 cup. This is the standard serving size. Do an actual count. Try to get within 10.

3. Using croutons, estimate the height of a paper cup, blackboard eraser, and bottle of glue. Then measure with the croutons and compare results.

4. Have students write ten ways they have used math outside the classroom in the last two weeks. Then indicate which times an exact answer or estimate was used. Categorize the groups as to paper and pencil, mental, or calculator. Ask their parents the same questions.

5. Use estimation in some everyday activities. For instance, how many times a day does the refrigerate door open? How many times do you chew your food at lunch. Have someone count. How many 1's are on the calendar? Count.

6. Play the "Switch Game". Using cards with short problems such as 6 children and 4 dogs results in how many legs, write the answers and switch cards every 15 seconds.

7. Using base ten blocks (flats, rods, and units) and an overhead projector, write three 2-digit numbers in a column on the chalkboard. Students round each number to the nearest ten and add to find the sum. Two students use the projector to show rounding with blocks, then add the rounded numbers. Students use the estimated sums to check the exact answers they computed mentally.

STRAND 7: ESTIMATION & MENTAL COMPUTATION

The Legend of the Cranberry : A Paleo-Indian Tale (1993)
by Ellen Greene
illustrated by Brad Sneed

Summary: This story is the retelling of the Indian legend in which the Great Spirit gave the world the cranberry. The cranberry reminds people of their great battle with the mastodons and woolly mammoths. This is also an excellent story to integrate with Ohio history.

Activities:

1. Read the book entirely through the first time.

2. Put a pound of cranberries in a clear container. Have each student estimate the number of cranberries in a pound. Collect answers for later. As a class, count the cranberries. Use a large piece of paper with a tens-and-ones chart. Put it on the floor and count ten cranberries into clear plastic cups. Set each cup in the tens column. Put any remaining cranberries in the ones column. Use the place value chart to determine the number of cranberries in a pound.

3. Discuss the estimated answers to judge the winner. Were some of estimations unreasonable? Repeat the activity using beans to see if understanding of the concept is increased.

4. Make cranberry bread or use this recipe for relish.
   1 pound fresh cranberries
   1 orange, peeled and seeded
   2 cups sugar
   Mix all ingredients in a blender. Refrigerate.

5. Make dye from the cranberries to use as ink or to finger paint on cloth to illustrate the story.

6. Discuss such animals as caribou, giant ground sloth, and saber-toothed cat. Research them and estimate their size using scaling.

STRAND 7: ESTIMATION & MENTAL COMPUTATION

Ragsale (1995)
by Artie Ann Bates
illustrated by Jeff Chapman-Crane

Summary: A girl tells of the family outing to ragsales all over the town. They make many stops and buy many different items. As it is always an adventure, ragsalin' makes Saturday a special family day. This book is also multicultural as it describes life in Appalachia.

Activities:

1. Read the book entirely through the first time.

2. Discuss the importance of estimating when shopping. Reread the story and practice the skill of estimation.

3. Make new prices for the items listed and estimate the purchase price.

4. Working in pairs, choose several items to purchase from an advertisement. One student will compute the sum with paper and pencil. The other one will estimate the sum. Compare answers.

5. Using a spinner with 0-8, make a three digit number in order of spins. Round to the nearest 100.

6. Collect items from home. Set up a ragsale with prices posted. Students practice estimation skills with concrete objects.

from the Ohio Model Competency-Based Mathematics Program:

STRAND 8: DATA ANALYSIS AND PROBABILITY

Understanding of the processes of data collection, representation, and interpretation is crucial in today's world. It is essential that students develop the ability to summarize and analyze data, to draw inferences, and to make accurate predictions and judgments based on that analysis.

Students should be given ample opportunities to examine real-world situations. This strand provides an excellent opportunity for students to become active participants in mathematics learning. The vast variety of potential topics for investigation provides the opportunity for considering a variety of interests and abilities, and thus makes the classroom a motivating and exciting place to be.

The study of data analysis should start in the early grades with the comparison, classification, and organization of objects, then proceed to the collection, organization, and representation of more abstract data through the use of tables, charts, graphs, and maps. Finally, students should learn to analyze the data, note trends, draw conclusions, and make predictions.

It is essential that students understand how statistics can be manipulated, and recognize the potential uses and misuses of statistical information.

The availability of computing technology presents today's students with the ability to perform statistical computations and comparisons which would have proved too unwieldy just a few short years ago.

Model Competency-Based Mathematics Program. Ohio Department of Education, 1990, November. p. 101.

STRAND 8: DATA ANALYSIS & PROBABILITY

The Banana Split from Outer Space (1995)
By Catherine Siracusa

Summary: Stanley's once booming ice cream business is failing because of the new highway. After he meets Zelmo, the alien, Stanley's ice cream stand flourishes.

Activities:

1. Read the book entirely through the first time.

2. Students survey twenty people concerning their favorite ice cream flavor. The results are then transferred to a bar graph. From this graph, students will compose questions to ask a partner.

3. Construct a shirt pictograph. Each student will color a shirt pattern according to their clothes of the day. On a wall, display the shirts in graph form. Students will make statements comparing the results.

4. Each student will choose a topic on which to create a line graph. After gathering the data, organize the information onto a graph. Interpret the graph with statements or questions.

5. Construct a circle graph from data pertaining to a survey about banana split toppings. In order to make a circle graph, string one hundred beads on a wire with every tenth bead being a different color. In this way, the percentages can be shown concretely and transferred to paper. Students can also create the banana splits from construction paper to visually show the combinations.

STRAND 8: DATA ANALYSIS & PROBABILITY

Do You Wanna Bet? (1991)
by Jean Cushman
illustrated by Martha Weston

Summary: Two boys discover that the most everyday events and activities such as card games, coin flips, and weather are dependent on probability. They learn many interesting facts as they deal with these situations.

Activities:

1. Read one chapter entirely through the first time.

2. Brainstorm situations that deal with the type of probability discussed in the chapter. Relate the activity to a personal experience. Share and discuss.

3. Since the boys toss a coin to decide which television show to watch, try the experiment with a partner. Toss a coin 100 times and record heads and tails. Repeat it several times. How close are the results to fifty for each?

4. Show the class three different spinners. Spinner A has four unequal sections. Discuss which section has the best chance of the spinner landing on it. Spinner B has four equal sections. Discuss which section has the best chance of the spinner landing on it. Spinner C has equal sections, but one number has two sections. Discuss which number has the greatest chance of the spinner landing on it. Divide the class into three groups. Give one spinner to each group. Predict the number of times the spinner will land in each section if they spin 25 times. Record and compare results.

5. Each pair of students will have a paper bag containing 1 yellow, 2 red, 2 green, and 5 blue unicubes. They choose from the bag five times and record results. The class will make a tally of their results. From this data, they will decide which cube is most likely to be picked and why. They will also decide which cube is least likely to be picked and why.

6. With a partner and a pair of dice, take turns throwing the dice. One player scores a point if the sum of the dice is 5, 6, 7, 8, or 9. The other player scores if the sum is 2, 3, 4, 10, 11, 12. Play until one player scores 10 points. Predict who will win before you play. Keep a tally of the numbers that appear. Repeat to see if the results are the same.

7. Roll a pair of dice. Add the two numbers and record the sums for 100 throws. Discuss the pattern that occurs.

STRAND 8: DATA ANALYSIS & PROBABILITY

Get Up and Go! (1996)
by Stuart J. Murphy
illustrated by Diane Greenseid

Summary: A girl tracks her morning as she gets ready for school. Many activities are listed along with the time needed to complete each one. It is written in rhyme and could be used with patterns as well.

Activities:

1. Read the book entirely through the first time.

2. Reread story pausing to assess how much time each activity takes and how much time elapses.

3. Draw pictures of each student's morning routine including minutes needed for each activity. Using string, create a personal time line.

4. Each student creates a time line of activities for the day. Compare which activities take the most time and which take the least.

5. Each student creates a time line of steps involved in preparing a favorite snack. Make sure the steps are in order and that it shows which steps take the most time.

6. As a year long class project, make a yarn timeline across the top of chalkboard. Record monthly topics, field trips, speakers, and holidays. This is an excellent activity in preparation for the Ohio Proficiency Test.

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CHAPTER IV

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this study was to assemble a handbook which integrates children's literature and mathematics for the upper primary classroom. The mathematics contained in the handbook supports the Standards established by the National Council of Teachers of Mathematics.

This author compiled this handbook after reviewing the current NCTM Standards for teaching mathematics as well as the Ohio State Model of Competency-Based Mathematics Program. Secondly, a statement of the philosophy of whole language was formed from using several authorities in the field. Thirdly, research was done in the area of integrated curriculum. Finally, this author reviewed current writings on the integration of children's literature and mathematics.

As a result of the above information as well as reviewing other handbooks, the project was completed. This handbook was critiqued by other upper primary teachers for revisions and input. These teachers are traditional and whole language in self-contained classrooms. They are also familiar with the Ohio Model of Competency-Based Mathematics Program.

The handbook itself contains an introduction, letter to teachers, and the table of contents that list the eight strands in the Ohio Model which supports the NCTM

Standards. These strands are: (1) Patterns, Relations, and Functions, (2) Problem-Solving Strategies, (3) Numbers and Number Relations, (4) Geometry, (5) Algebra, (6) Measurement, (7) Estimation and Mental Computation, and (8) Data Analysis and Probability. Each strand contains three literature selections with suggested activities. Finally, a book list contains the literature used in each strand.

Conclusions

After completing this handbook, this author feels that it could be used as a supplement to any mathematics program in the upper primary classroom. Furthermore, this author believes that the activities could be used with all students in primary school with minor adaptations.

Recommendations

Most of the children's literature selected was from 1990 to 1995. It is suggested that teachers add new pertinent literature to the handbook as it becomes available.

This author also feels that a research project could be formulated using this handbook. A comparison could be done with one group using traditional methods while the other supplements the instruction with this handbook.

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