ALGEBRAIC THINKING (Strand D)

Number Sentences/Number Sense (Standards 1 and 2)

1. Merriam, Eve. ***12 Ways to Get to 11***. New York: Simon & Schuster Books, 1993.

   This book explores number sentences as it investigates many different ways to reach the number 11.

   · Have students pick a number. Have them write as many different number sentences as possible. Encourage students to use more than two numbers, more than one operation, and to write the sentences using the correct order of operations.

2. Hulme, Joy N. ***Sea Sums***. New York; Hyperion Books for Children, 1996.

   Addition and subtraction problems are told in an ocean theme.

   · Have students create a book of their own along the same lines, writing number sentences to describe the pages of their book. Also, the ideas for use with ***12 Ways to Get 11*** are appropriate here.

3. Dee, Ruby. ***Two Ways to Count to Ten***. New York: Henry Holt and Company, 1988.

   The leopard king is seeking a husband for his daughter. The animal who is able to toss a spear into the air and count to ten before it hits the ground wins. This tale indicates that sometimes the cleverest is the winner.

   · Before reading the book, have students try to count to twenty as fast as possible and record the times. After reading the book, connect the different ways to count to a number to the factors of the number.

Patterns and Variables (Standard 1)

4. Falconer, Elizabeth. ***The House That Jack Built***. Nashville, TN: Ideals Children's Books, 1990.

This book describes a growing pattern, from the house that Jack built to the farmer who sows corn.

- Have students create repeating and growing patterns, grouping patterns with the same basic structure together.

5. Scieszka, Jon and Lane Smith. ***The Stinky Cheeseman and other Fairly Stupid Tales***. New York: Viking, 1992.

Many favorite fairy tales are told from a more modern perspective. Particular stories that emphasize patterns are "The Princess and the Bowling Ball," "Jack's Story," and "The Stinky Cheese Man."

- After reading all of these books, give children a strip of adding machine tape. Have them draw a pattern on their strip, making sure they draw at least two cycles of their pattern. Then have the children sort their patterns on the classroom wall so that like patterns are grouped together. Children need to justify why patterns in a group are alike and identify the pattern as ABAB, etc. (This activity is described more fully in the NCTM Addenda Series ***Patterns K-6***.)

6. Mitsumasa, Anno. ***Anno's Math Games II.*** New York: Putnam & Grosset, 1997.

A wide range of mathematics topics are illustrated through diagrams. The section on The Magic Machine deals with ideas connected to a function machine. The section on Counting with Circles provides a nice introduction to ideas connected with variables.

- Read the pages in the section on The Magic Machine. Have children identify what each machine does. Then have children create their own "function" machine. Read the section on Counting with Circles. Have students create similar pages of their own.

Patterns, Tables, and Rules (Standard 1)

7. Pinczes, Elinor J. ***One Hundred Hungry Ants***. Boston: Houghton Mifflin, 1993.

   One hundred ants are marching to a picnic. They arrange themselves into rows of different sizes in order to get to the picnic faster.

   · Have children complete the following chart.

Number of Columns	Number of Ants in a Column
1	100
2	

Write a rule that describes the pattern in the table. Graph the results.

8. Hutchins, Pat. ***The Doorbell Rang***. New York: Mulberry Books, 1986.

   A plate of cookies is divided among several children. The number of children changes each time the doorbell rings.

   · Do the same things as with ***A Hundred Hungry Ants.***

9. Giganti, Paul, Jr. ***Each Orange Had 8 Slices***. New York: Greenwillow Books, 1992.

   Each page of this book contains several problems, with multiplication as the focus.

   · Take any page of the book. Create a table to illustrate the relationships that are described. Try to write one or more rules for the relationships. Graph the results. Connect the steepness of the graphs to ideas of slope.

10. Hulme, Joy N. ***Sea Squares***. New York: Hyperion Books, 1991.

    This counting book uses an ocean theme as it explores multiplication patterns of the form n x n, from 1 x 1 to 10 x 10.

    · Have children consider the next few numbers in the pattern. Have children write a rule to describe their pattern. If appropriate, introduce the notation for exponents.

11. Anno, Masaichiro and Mitsumasa Anno. ***Anno's Mysterious Multiplying Jar***. New York: Philomel Books, 1983.

A jar contains an island on which are two countries. Each country contains three mountains. The patterns continue until there are 10! jars.

- Have children relate the descriptions in the book to multiplication. If appropriate, introduce factorial notation. Have children create their own multiplication book. Relate the ideas in the book to problems connected with the Multiplication Counting Principle. [e.g., Nine people are on a baseball team. Without any restrictions, how many batting orders are possible?]

12. Goble, Paul. ***Her Seven Brothers***. New York: Aladdin Paperbacks, 1988.

A young girl searches for seven brothers she does not know. Through a series of adventures, they become the Big Dipper. The story is based on a Cheyenne legend.

- Have children create designs using colored toothpicks. Have them describe the number of toothpicks of a given color needed for 1, 2, 3, 4, ..., 100 of their designs. Write a rule that tells a company how many colored toothpicks they need to have if someone orders a given number of your design. (Activities with sample children's work are described in a chapter by Thompson, Chappell, and Austin in the forthcoming Addenda series on Changing the Faces of Mathematics: Perspectives on Indigenous Peoples.)

<u>More Advanced Patterns -- Exponential Growth (Standard 1)</u>

13. Hong, Lily Toy. ***Two of Everything***. Morton Grove, IL: Albert Whitman & Company, 1993.

A couple finds a brass pot which doubles everything placed into it. The couple's life changes dramatically.

- Suppose you start with 5 coins and place them in the pot. Continue doubling the results and record the values in a table. How long will it take before you have 1000 coins? What if you had a triple pot? What if you started with 1000 coins and had a half-pot? How long would it take before you have less than 50 coins?

14. Losi, Carol A. ***The 512 Ants on Sullivan Street***. New York: Scholastic, 1997.

Ants at a picnic keep doubling until they steal all the food.

- If the pattern continues, how many ants would be needed for the next three food items? Find the total number of ants each time a new food is added to the story. Try to write rules to describe your patterns. Graph the number of ants with each food and the total number of ants.

15. Birch, David. ***The King's Chessboard***. New York: Puffin Pied Piper Books, 1988.

A wise man does a service for a king who insists on giving a reward. The wise man requests one grain of rice for the first square of a chessboard, with the number of grains doubling for each new square of the chessboard. The king eventually realizes that there would not be enough rice in all the world to meet the wise man's request.

16. Barry, David. ***The Rajah's Rice: A Mathematical Folktale from India***. New York: W. H. Freeman and Company, 1994.

A young girl heals the rajah's sick elephants. She then defeats the rajah by requesting a reward of rice in which the number of grains doubles each day until all the squares of a chessboard are covered.

17. Demi. ***One Grain of Rice: A Mathematical Folktale***. New York: Scholastic, Inc., 1997.

A young girl uses her wits to help starving people and teach the wicked rajah a lesson. This is another variant on the doubling tale.

18. Pittman, Helena Clare. ***A Grain of Rice***. New York: Bantam Skylark Book, 1986.

A humble servant gets one grain of rice on the first day from the Emperor, with the number of grains of rice set to double each day for 100 days.

- For all four of these books, have children create a table with the number of grains of rice on each square of the chessboard or each day of the specified period. Have children describe the patterns they see and graph the results, if possible. Have children explore weight and space issues connected to the quantities of rice.

19. Chwast, Seymour. ***The 12 Circus Rings***. San Diego: Gulliver Books, 1993.

This book explores multiplication and sequences as readers explore the objects in each of 12 circus rings.

- Record the number of new animals, people, etc. who enter each of the circus rings. Also record the total number of people who are in a given ring.

Circus ring	Number of new objects in this circus ring	Total number of objects in this circus ring	Total number of objects in circus in all the circus rings
1	1	1	1
2	2	3	4
3	3	6	10
4			

20. Anno, Mitsumasa. ***Anno's Magic Seeds***. New York: Philomel Books, 1995.

Two magic seeds are given to a young man. When a seed is buried, it produces two seeds the following year. A variety of patterns are explored in this book.

- Have children keep a record of the number of seeds Jack plants and picks each year throughout the story. This information can be graphed.

Equations (Standard 2)

21. Edens, Cooper. ***How Many Bears?*** New York: Atheneum, 1994.

The number of bears needed to run a bakery is determined by solving mathematical clues given throughout the book.

- Have children solve the equations described in the hints on each page. Have children make their own book so that not all the pages lead to the same final result.

Miscellaneous (classification)

22. Lowell, Susan. ***The Three Little Javelinas***. Flagstaff, AZ: Northland Publishing Company, 1992.

    The story of the three little pigs is retold with a southwest flavor.

23. Laird, Donivee Martin. ***The Three Little Hawaiian Pigs and the Magic Shark***. Honolulu, HI: Barnaby Books, 1981.

    This retelling of the classic three little pigs story has a Hawaiian flavor.

24. Scieszka, Jon. ***The True Story of the 3 Little Pigs!*** New York: Puffin Books, 1989.

    The story of the three pigs is told from the point of the wolf.

- After reading the three versions of the ***Three Little Pigs***, have children use a Venn diagram to explore the similarities and differences among the various versions. Identifying attributes and characteristics is an important part of algebraic thinking.