

OHIO ACADEMIC CONTENT STANDARDS

- **Numerical Patterns (Grade 1) Y2003.CMA.S04.GPK-02.BB.L01.I02**

Extend sequences of sounds, shapes or simple number patterns, and create and record similar patterns.

- **Explaining Patterns (Grade 1) Y2003.CMA.S04.GPK-02.BC.L01.I03**

Describe orally the basic unit or general plan of a repeating or growing pattern.

- **Problem Solving (Grade 1) Y2003.CMA.S04.GPK-02.BE.L01.I04**

Solve open sentences by representing an expression in more than one way using the commutative property; e.g., $4 + 5 = 5 + 4$ or the number of blue balls plus red balls is the same as the number of red balls plus blue balls ($R + B = B + R$).

- **Number and Number Systems (Grade 1) Y2003.CMA.S01.GPK-02.BA.L01.I05**

Use place value concepts to represent whole numbers using numerals, words, expanded notation and physical models with ones and tens.

- **Meaning of Operations (Grade 1) Y2003.CMA.S01.GPK-02.BH.L01.I12**

Use conventional symbols to represent the operations of addition and subtraction.

- **Meaning of Operations (Grade 1) Y2003.CMA.S01.GPK-02.BG.L01.I10**

Model, represent and explain addition as combining sets (part + part = whole) and counting on.

- **Meaning of Operations (Grade 1) Y2003.CMA.S01.GPK-02.BH.L01.I11**

Model, represent and explain subtraction as take-away and comparison.

ALGEBRA

FOCUS

- ◆ Using number sentences to model real world problems.

VIDEO “Creepy Crawlies”

Ohio Academic Content Standards

- Problem Solving (Math Grade 1)
Y2003.CMA.S04.GPK-02.BE.L01.I04
- Unknown Quantities (Math Grade 2)
Y2003.CMA.S04.GPK-02.BF.L02.I06
- Heredity (Science Grade 2)
Y2003.CSC.S02.GKG-02.BC.L02.I04
- Problem Solving (Math Grade 3)
Y2003.CMA.S04.G03-04.BE.L03.I04

Ms. Davis, the librarian, plays a joke on the five MathTek kids by putting plastic ants on cookie treats which results in some cookie smashing. An investigation using algebra develops when Caitlin wonders whether there will be enough cookies left for all of them to share equally. By comparing numbers, writing number sentences, and finding missing factors using manipulatives, the group solves the algebra problem.

The introduction of an ant farm and several interesting insects and arachnids brought by Ms. Robinson, a zoo educator, initiates a discussion of habitat and rainforests. The group then uses the algebra concepts they have learned to determine how many legs are needed to complete the spider that Nigel makes from construction paper.

VOCABULARY

- ◆ **Variable.** A symbol or letter representing one or more values.

JOURNAL TOPICS

1. Write a number story with words that describe a problem you have had.
2. How did you figure out how to win Poison Spider? (see Extension 2.)

3. What kind of bug would you like to be? Why?

EXTENSIONS

I. FACT FAMILIES

Ohio Academic Content Standards

- Problem Solving (Math Grade 1)
Y2003.CMA.S04.GPK-02.BE.L01.I04
- Numerical Equivalence (Math Grade 2)
Y2003.CMA.S04.GPK-02.BE.L02.I05
- Problem Solving (Math Grade 3)
Y2003.CMA.S04.G03-04.BC.L03.I05
- Mathematical Equations (Math Grade 3)
Y2003.CMA.S04.G03-04.BC.L03.I06

Materials Needed: Unifix cubes, Fact Family House worksheets (Appendix 3A)

- ◆ Give each group or pair of students eight unifix cubes— five of one color and three of another color. Ask them to link both sets of colors together and discover two addition number sentences about them ($5+3=8$ and $3+5=8$). Write the number sentences on the board. Now ask them to take the two color sets apart and discover two subtraction number sentences about them ($8-5=3$ and $8-3=5$). Try this activity with other number combinations of two colors. Explain that for any two numbers and their sum, there is a family of four facts (or number sentences). Explore this concept using the Fact Family House worksheet (Appendix 3A). Three numbers for each house can be assigned or determined by the students.
- ◆ Expand the fact family concept by having groups or pairs of students see how many different number sentences they form that have the sum of eight. It will help Level I students if they work with eight unifix cubes of the same color for this activity. Challenge

them to come up with a pattern for finding the list of sums ($0+8=8$, $1+7=8$, $2+6=8$, etc.). A challenge for higher level students would be to discover a rule about how many number sentences can be written to equal the same total for the sum of any two numbers. (You can always write a total number of sentences that is one more than the answer. For example, there are nine number sentences for the sum of eight.)

- ◆ Have higher Level students experiment with sums and differences for a certain number. Ask if a pattern will help create a list of differences as well as sums. Ask whether or not there is a rule that applied to this activity.
*The MathTek CD activity “Number Cruncher” offers three levels of practice with addition, subtraction, multiplication, and division facts.

2. POISON SPIDER GAME

Ohio Academic Content Standards

- Meaning of Operations (Math Grade 1)
Y2003.CMA.S01.GPK-02.BH.L01.I12
- Pattern Predictions (Math Grade 2)
Y2003.CMA.S04.GPK-02.BC.L02.I02
- Meaning of Operations (Math Grade 3)
Y2003.CMA.S01.G03-04.BL.L03.I09

Materials Needed: Poison Spider Web Mats (Appendix 3B), counters

- ◆ Teach the class the game Poison Spider. You can make and laminate spider web mats (Appendix 3B) and use small plastic spiders or any available counters. For Level 1 students, the game is very simple. They have a mat with 10 spiders (or counters) between them. They alternately take one or two spiders from the pile until there are none left. The person who takes the last spider, the “poison” one, loses. Students quickly get the idea that whoever leaves one at the end of their turn is

going to win. Eventually, they will realize that whoever leaves four at the end of their turn is also going to win. Finally, they should see leaving seven is also a winning position. It is important to let them discover these facts for themselves. It is also fun as the teacher to circulate through the class and let students try to “poison” you. You already know how to win!

- ◆ Another strategy is to have students play the game in groups of four (one pair playing against another). Partners discuss their moves with each other (secretly, of course).
- ◆ Level 2 and 3 students can play variations of Poison Spider. For example, they might start with 25 blocks and each take one, two, three or four at a turn. Continue to encourage them to look for and articulate possible strategies.
- ◆ This type of game can also be played with a calculator—starting by entering 10 and each player subtracting one or two each turn.

3. NUMBER BALANCING

Ohio Academic Content Standards

- Number and Number Systems (Math Grade 1)
Y2003.CMA.S01.GPK-02.BA.L01.I05
- Numerical Comparisons (Math Grade 3)
Y2003.CMA.S01.G03-04.BA.L03.I03

Materials Needed: Base ten blocks, spinners (Appendix 3C), recording sheets (Appendix 3D), balance scale

- ◆ Help students begin to understand the concept of “Greater Than or Less Than” by playing a balancing game. Each pair of students will need a set of base ten blocks, two recording sheets (Appendix 3D), a balance scale, and a spinner (Appendix 3C). Level 1 students can work with just ones; Level 2 and 3 students with ones and

- Numerical Patterns (Grade 2) Y2003.CMA.S04. GPK-02.BB.L02.I01

Extend simple number patterns (both repeating and growing patterns), and create similar patterns using different objects, such as using physical materials or shapes to represent numerical patterns.

- Pattern Predictions (Grade 2) Y2003.CMA.S04. GPK-02.BC.L02.I02

Use patterns to make generalizations and predictions; e.g., determine a missing element in a pattern.

- Representing a Problem (Grade 2) Y2003.CMA.S04. GPK-02.BD.L02.I04

Use objects, pictures, numbers and other symbols to represent a problem situation.

- Numerical Equivalence (Grade 2) Y2003.CMA.S04. GPK-02.BE.L02.I05

Understand equivalence and extend the concept to situations involving symbols; e.g., $4 + 5 = 9$ and $9 = 4 + 5$, and $4 + 5 = 3 + 6 =$.

- Unknown Quantities (Grade 2) Y2003.CMA.S04. GPK-02.BF.L02.I06

Use symbols to represent unknown quantities and identify values for symbols in an expression or equation using addition and subtraction.

- Meaning of Operations (Grade 2) Y2003.CMA.S01. GPK-02.BI.L02.I07

Model, represent and explain multiplication as repeated addition, rectangular arrays and skip counting.

- Meaning of Operations (Grade 2) Y2003.CMA.S01. GPK-02.BJ.L02.I08

Model, represent and explain division as sharing equally and repeated subtraction.

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- **Heredity (Science Grade 2)**
Y2003.CSC.S02.GKG-02.BC.L02.104

Compare similarities and differences among individuals of the same kind of plants and animals, including people.

- **Repeating Patterns (Grade 3)** Y2003.CMA.S04.G03-04.BA.L03.102

Analyze and replicate arithmetic sequences with and without a calculator.

- **Numerical Comparisons (Grade 3)** Y2003.CMA.S04.G03-04.BA.L03.103

Use mathematical language and symbols to compare and order; e.g., less than, greater than, at most, at least, $<$, $>$, $=$.

- **Problem Solving (Grade 3)** Y2003.CMA.S04.G03-04.BE.L03.104

Model problem situations using objects, pictures, tables, numbers, letters and other symbols.

- **Problem Solving (Grade 3)** Y2003.CMA.S04.G03-04.BC.L03.105

Write, solve and explain simple mathematical statements, such as $7 +$.

- **Mathematical Equations (Grade 3)** Y2003.CMA.S04.G03-04.BC.L03.106

Express mathematical relationships as equations and inequalities.

- **Discovering Patterns (Grade 3)** Y2003.CMA.S04.G03-04.BF.L03.107

Create tables to record, organize and analyze data to discover patterns and rules.

- **Meaning of Operations (Grade 3)** Y2003.CMA.S04.G03-04.BL.L03.109

Model, represent and explain division; e.g., sharing equally, repeated subtraction, rectangular arrays and area model.

tens, or even hundreds. Students take turns spinning a paper clip on the spinner once to determine the number of ones blocks to place on their side of the balance scale, and again to determine the number of tens to include (a third spin determines the number of hundreds). It should be decided before play begins whether the greater or lesser number will be the winning number for that game. The students record their tens and ones on paper and write the resulting number. For example, 6 ones and 2 tens would be 26. The other partner takes a turn doing the same, spinning, placing blocks in their balance pan, and recording their number. Partners then observe the balance to see which number is greater (heavier) or less (lighter), whichever has been determined to be the winning number for that game. The winning partner circles his/her number on the recording sheet. Blocks are removed and another turn is taken by both.

- ◆ To play a game of Greater Than/Less Than, partners can each take 10 turns and then count to see who had the most Greater or Less numbers for that game.

4. MISSING FACTORS

Ohio Academic Content Standards

- Representing a Problem (Math Grade 2)
Y2003.CMA.S04.GPK-02.BE.L01.104
- Problem Solving (Math Grade 3)
Y2003.CMA.S04.GPK-02.BD.L02.104
- Mathematical Equations (Math Grade 3)
Y2003.CMA.S04.GPK-02.BF.L02.106

Materials Needed: M&Ms, paper cups, Symbols worksheets and puzzle cards (Appendix 3E and 3F), counters

- ◆ Ask two students to assist with an introductory problem. Without the class seeing, give the first student

seven M&Ms and the second student six M&Ms. In front of the class, have the first student put the seven M&Ms in a paper cup, counting them aloud as they are put in. Have the second student put the six M&Ms in the same cup without showing or counting them. Explain that the problem is to find out how many M&Ms the second student had. Call that number “M” or the mystery number. Ask groups to brainstorm a way to write a number sentence about what we do know so far ($7+M=?$). Have students pair up to think of a way to find out the mystery number. Pairs share ideas within their group and then with the class. Someone may come up with the idea of counting the total number of M&Ms in the cup. If not, you can suggest that it is allowable to count the M&Ms, if they want to. Once this is done, write the number sentence $7+M=13$. Have pairs of students think of a way to find the value of the variable “M” (subtracting 7 from 13, or for Level 1 students, counting up from 7 to 13). Repeat the activity with a variety of numbers.

- ◆ Expand on this activity by calling two more students to help. Have the first student count and put 11 M&Ms in the cup. Have the second student take out some M&Ms without showing anyone how many he or she took. Repeat the think, pair, and share process for writing the number sentence ($11-M=?$) to determine the value of “M.” Repeat this activity with a variety of numbers.
- ◆ Give each group of students a Symbols Worksheet and a Puzzle Card Set (cut out and placed in envelopes). Explain that each of the shape symbols on the worksheet has a number value. Each group has to try to determine the number values by using the number sentence clues on the cards. Each group member takes one card.

Everyone reads his or her card and each group then determines the symbol number values. Ask groups to explain how they determined their values. Level 1 students should be given manipulative counters to help them complete the work.

5. USING CALCULATORS

Ohio Academic Content Standards

- Numerical Patterns (Math Grade 1)
Y2003.CMA.S04.GPK-02.BB.L01.I02
- Explaining Patterns (Math Grade 1)
Y2003.CMA.S04.GPK-02.BC.L01.I03
- Numerical Patterns (Math Grade 2)
Y2003.CMA.S04.GPK-02.BB.L02.I01
- Repeating Patterns (Math Grade 3)
Y2003.CMA.S04.G03-04.BA.L03.I02

Materials Needed: Calculators, pencil, paper

- ◆ The use of calculators by primary students is recommended by the Ohio Mathematics Content Standards. This tool can be of use in teaching the algebraic concept of patterns and can help lay the foundation for the multiplication and division algorithms. Calculators that have an arithmetic constant capability for addition are suggested. To check and see if the calculators you have available have this feature, press $2 + = = =$, or $0 + 2 = = =$, or $2 + + +$. If one of these sequences produces the successive display of 2, 4, 6, 8, etc., then the calculators have an arithmetic constant.
- ◆ Give each pair of students paper, pencil, and a calculator. For Level 1 students, begin by showing them how to count with their calculators. Demonstrate by pushing $+ 1 =$ on a calculator. The number 1 will appear on the display. If you push $=$ again, the display will show 2. Have them continue to push $=$ to continue counting on their calculators. Demonstrate how calculators can be cleared by pushing the clear button. Ask if they can count by twos on their calculators. Push $+ 2 =$. Ask what they predict they will see if they push the $=$ button two more times. What happens when they push the $=$ button five times? Continue practicing counting by fives and tens this way. Ask for predictions and whether or not they think certain numbers will appear in specific sequences. For example, ask, "Do you think that 33 will be one of the numbers we see when counting by fives? Why or why not?" Recording the numbers they see in the displays will help them to recognize patterns and to predict what will or will not happen. Hundreds charts and markers could also be used to record patterns and results.
- ◆ Level 2 and 3 students can begin investigating skip counting by less traditional methods. Again, recording results helps them to see the process. Ask students to key in a number on their calculators, 3 for example. Have them begin to add another number (4) and begin to skip count and record the sequence that appears in the display. They would be entering $13 + 4 = = =$. Ask whether or not they begin to see a pattern and ask them to predict whether or not a certain number will appear in the sequence, 58 for example. Ask why or why not and how they could find out. Have students practice with other numbers, recording the sequences.
- ◆ Have partners challenge each other by writing a sequence of numbers and asking what comes next. Pose another challenge to students by writing a sequence of numbers on the board and asking whether or not that sequence was a result of skip counting (for example 16, 29, 52, 64, etc.).

ALGEBRA

6. NUMBER STORIES

Ohio Academic Content Standards

- Meaning of Operations (Math Grade 1)
Y2003.CMA.S01.GPK-02.BH.L01.I11
- Problem Solving (Math Grade 1)
Y2003.CMA.S04.GPK-02.BE.L01.I04
- Meaning of Operations (Math Grade 1)
Y2003.CMA.S01.GPK-02.BG.L01.I10
- Numerical Equivalence (Math Grade 2)
Y2003.CMA.S04.GPK-02.BE.L02.I05
- Meaning of Operations (Math Grade 2)
Y2003.CMA.S01.GPK-02.BI.L02.I07
- Meaning of Operations (Math Grade 2)
Y2003.CMA.S01.GPK-02.BJ.L02.I08
- Problem Solving (Math Grade 3)
Y2003.CMA.S04.G03-04.BC.L03.I05

Technology Used: Any presentation/slideshow software

- ◆ Have pairs of students create math problems (addition, subtraction, multiplication, or division) using manipulatives while verbalizing to each other what they are doing. Using the software, students next illustrate their number stories on the computer and write out the story in words. Have students print out their stories and assemble into a class number story book.

7. MATHTEK CD ACTIVITIES

Sign Up

Ohio Academic Content Standards

- Representing a Problem (Math Grade 2)
Y2003.CMA.S04.GPK-02.BD.L02.I04
- Unknown Quantities (Math Grade 2)
Y2003.CMA.S04.GPK-02.BF.L02.I06
- Problem Solving (Math Grade 3)
Y2003.CMA.S04.G03-04.BC.L03.I05
- Mathematical Equations (Math Grade 3)
Y2003.CMA.S04.G03-04.BC.L03.I06

Twenty number sentences are given randomly at each of three levels. Operation signs are missing and the student must choose the correct sign

and place it where it belongs in the sentence. Levels 1 and 2 present addition and subtraction sentences. Level 3 includes some multiplication and division.

Missing Factor

Ohio Academic Content Standards

- Meaning of Operations (Math Grade 1)
Y2003.CMA.S01.GPK-02.BH.L01.I12
- Unknown Quantities (Math Grade 2)
Y2003.CMA.S04.GPK-02.BF.L02.I06
- Problem Solving (Math Grade 3)
Y2003.CMA.S04.G03-04.BC.L03.I05
- Mathematical Equations (Math Grade 3)
Y2003.CMA.S04.G03-04.BC.L03.I06

Each of three levels in this activity provide 25 randomly selected number sentences, each with a missing factor. Students must enter the missing number that belongs in the answer space.

Number sentences are presented both vertically and horizontally. Levels 1 and 2 use addition and subtraction. Level 3 uses addition and subtraction and includes multiplication and division.

Line Sums

Ohio Academic Content Standards

- Numerical Equivalence (Math Grade 2)
Y2003.CMA.S04.GPK-02.BE.L02.I05
- Repeating Patterns (Math Grade 3)
Y2003.CMA.S04.G03-04.BA.L03.I02
- Discovering Patterns (Math Grade 3)
Y2003.CMA.S04.G03-04.BF.L03.I07

Four puzzles are presented at each of three levels. Using the numbers provided, students must place them in the puzzles so that lines in every direction equal a specified number. Multiple solutions are possible.

Number Cruncher

Ohio Academic Content Standards

- Unknown Quantities (Math Grade 2)
Y2003.CMA.S04.GPK-02.BF.L02.106
- Problem Solving (Math Grade 3)
Y2003.CMA.S04.G03-04.BC.L03.105

This timed activity uses a function which is established at the beginning of each variation (+2, for example). One at a time, ten random numbers tumble into the machine creating a number sentence. The student must enter the answer to the equation before the Number Cruncher calculates the answer. Each level contains eight different functions. Ten random equations are provided for each function. Levels 1 and 2 use addition and subtraction. Level 3 uses multiplication and division.

- ◆ *Number Bond Machines*
<http://www.amblesideprimary.com/ambleweb/mentalmaths/numberbond.html>
- ◆ *Addition Machine*
<http://www.amblesideprimary.com/ambleweb/mentalmaths/additiontest.html>

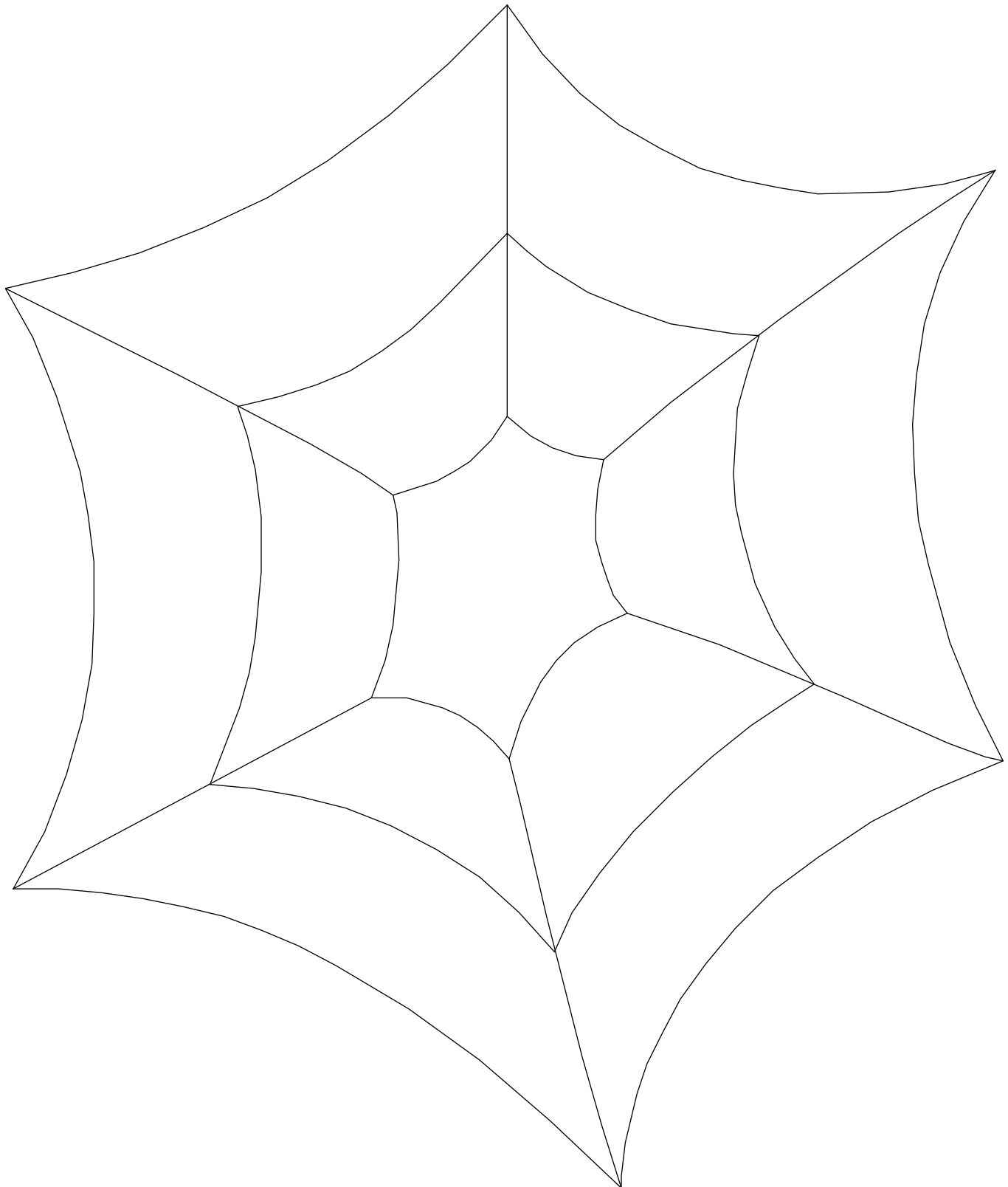
8. ADDITIONAL RESOURCES

- ◆ *Introduction to Algebra for Primary Students*
<http://mathforum.org/varnelle/kalg.html>
- ◆ *Fact Family Cards*
<http://www.mathcats.com/explore/factfamilycards.html>
- ◆ *Basic Multiplication*
<http://www.dositey.com/muldiv/basicmult.htm>
- ◆ *Find the Missing Factors*
http://www.quiz-tree.com/Elementary-Math_Find-Missing-Factors_2_MC-4.html
- ◆ *Online Calculator*
<http://www.amblesideprimary.com/ambleweb/mentalmaths/Calculator.html>
- ◆ *Number Lines*
<http://www.amblesideprimary.com/ambleweb/mentalmaths/numberlines.html>

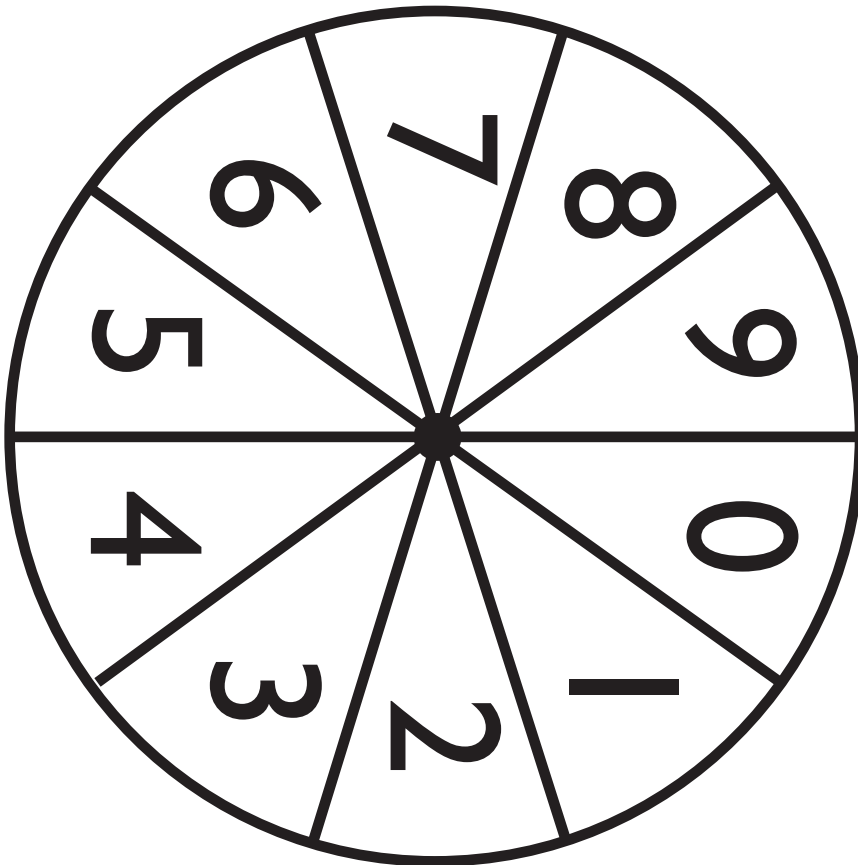
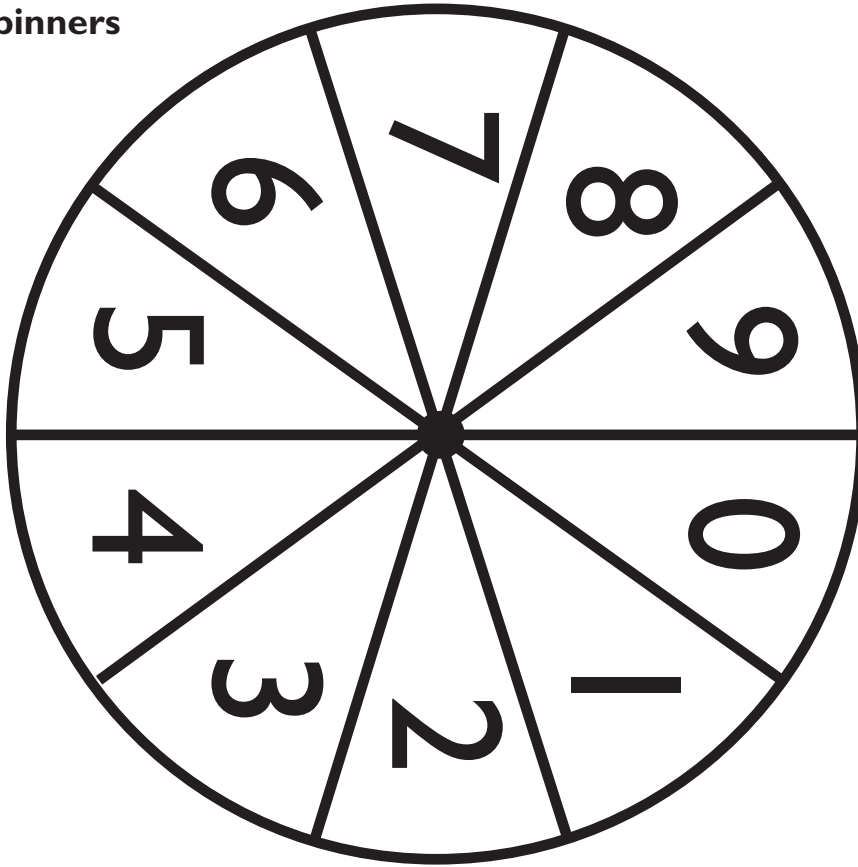
Fact Family House

The diagram shows a house-like structure with a roof and a chimney. The roof is a large black arrow pointing right. The chimney is a small house with a gabled roof, located on the right side. The main body of the house is a large rectangle divided into four vertical columns by three vertical lines. The left side of the house is decorated with a vertical row of stylized trees. The roofline is a horizontal line at the top, and the base is a horizontal line at the bottom. In the center of each column, there is a plus sign (+) and an equals sign (=). The plus signs are positioned between the top and middle horizontal lines, and the equals signs are positioned between the middle and bottom horizontal lines.

Poison Spider Web Mat



Number Spinners



Greater Than/Less Than Recording Sheet

1.

tens	ones

2.

tens	ones

3.

tens	ones

4.

tens	ones

5.

tens	ones

6.

tens	ones

7.

tens	ones

8.

tens	ones

9.

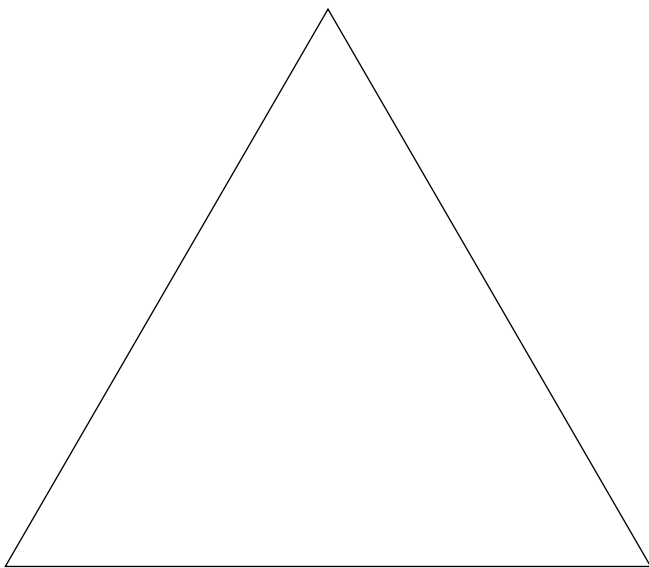
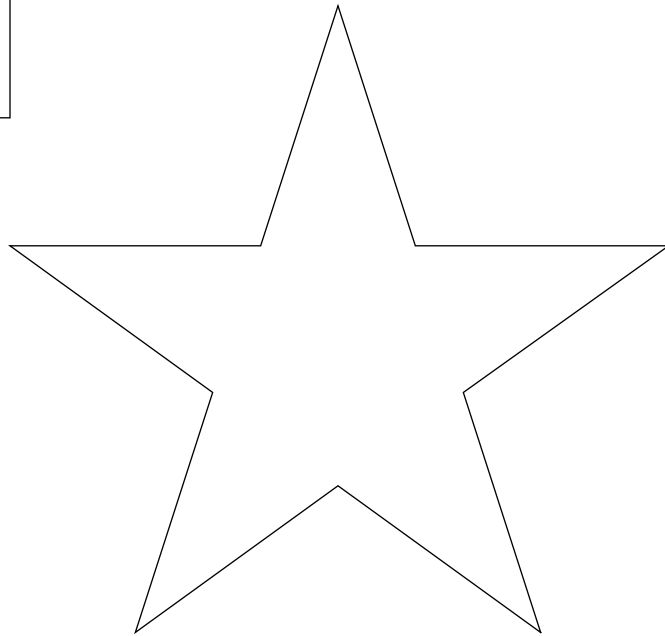
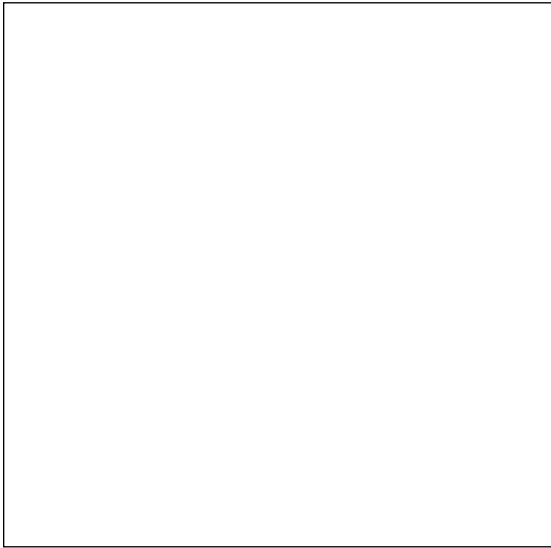
tens	ones

10.

tens	ones

Number Symbols

Find the value of each symbol.



Puzzle Cards

$$\square + \triangle = \star$$

$$\star - \square = 2$$

$$\square + 1 = 6$$

$$\star + \triangle = 9$$