

Grades  
K-2

# Number and Operation

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# About How Many?

# 1

## Overview

### Mathematical Focus

- ▶ Estimation
- ▶ Number sense
- ▶ Number relationships

Opportunities to estimate help students develop an intuitive feeling for quantity. Students recognize that an estimate is an approximation. With practice they begin to judge the correct order of magnitude of an estimate using benchmarks, such as 10 or 20. They invent and develop other strategies for estimating, such as forming a mental picture of the size of a unit and using that mental picture to estimate larger collections of objects.

### Materials & Preparation

**Before the session, gather the following materials:**

- ▶ Counters, approximately 20 of each of two colors
- ▶ Counting mat (a blank sheet of paper)

Throughout this unit, counters will be used in several of the activities. A variety of readily available materials can be used as “counters”—colored plastic chips, macaroni, beans, toothpicks, marbles. For Part 1 of this activity, you will need the same type of counter in two different colors.

# Activity

## More or Less?

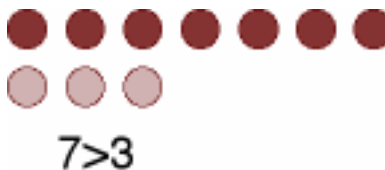
- 1. Estimate the number of counters of each color in a group of ten counters.**

While students cover their eyes, put 10 counters of two colors (e.g., red and yellow) on the table. Tell students there are 10 counters and ask them to estimate the number of red counters *without counting*. Ask:

- ♦ *Are more than half of the counters red?*
- ♦ *Is the number of red counters more than 5?*
- ♦ *Is the number of red counters less than 5?*
- ♦ *How did you decide?*

- 2. Compare the number of counters of each color.**

Have students line up the counters to compare the number of each color. Ask them to say the number of each color, and which is greater.



*Teaching Tip*

For younger children, you may want to begin with 5 counters.

- 3. Explore different numbers of counters and different ratios of colors.**

Try the same activity with 20 counters of two colors. Ask:

- ♦ *Are more than half of the counters red?*
- ♦ *Is the number of red counters more than 10?*
- ♦ *Is the number of red counters less than 10?*
- ♦ *How did you decide?*

## Teaching Tip

Students often find it easier to make an estimate from fixed choices, such as “more than 10” or “less than 10,” than making an estimate of the approximate number.

## Quick Glance

### 1. Use ten counters as a benchmark to guess how many counters are in another group.

Have students count a group of 10 counters to verify that there are 10. Students will use this group of 10 counters as a visual guide, or *benchmark*, for estimating the number of counters in other groups. While students cover their eyes, put 8 counters in a second group. Invite students to take a quick glance at both groups and then cover the group of eight counters with a piece of paper. Ask:

- ♦ *Were there more than 10 counters in the second group, less than 10, or 10?*
- ♦ *About how many counters do you think were in the second group?* [Emphasize that you want an estimate.]
- ♦ *How did you decide?*

Show the second group again and ask students to count or compare.

### 2. Guess how many counters are in other groups, still using 10 as a benchmark.

Keep 10 counters in the first group and try putting 15 counters in the second group, then 20 counters, and so on. Ask the same questions.

# Show My Number

## Overview

### Mathematical Focus

- ▶ Representation of numbers
- ▶ Number relationships
- ▶ Number sense

As students develop concepts of number, they need many and varied opportunities to explore numbers and number relationships. In this activity, students use counters and several different counting mats to represent numbers. They explore the relationship between parts of a number and the whole, e.g., six can be thought of in terms of parts: two and four, three and three, five and one, and so on. They also develop the notion of five and 10 as benchmarks.

### Materials & Preparation

**Before the session, gather the following materials:**

- ▶ Counters
- ▶ Student Page 1: Part-Part-Whole Mat, 1 copy
- ▶ Student Page 2: Number Cards, 0–9, 1 copy

Cut out Number Cards ahead of time. Save number cards for use in future activities.

# Activity

## Show My Number

1. **Display numbers between 1 and 20 using counters.**

Ask students to use the counters to show some of the numbers from 1 to 20 using counters and to count each group of counters aloud.

## Undercover Counters

2. **Discover how many counters are covered by examining the counters that are visible.**

Put out some counters and have students count them. Cover some of the counters while students cover their eyes. Ask: *How many counters are covered?* Take turns covering counters.

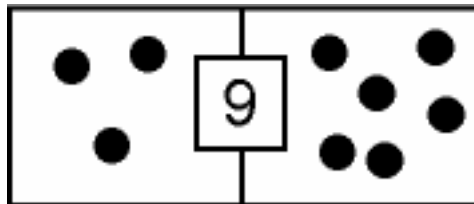
### Teaching Tip

When it is your turn to say how many counters are covered, demonstrate a counting-on strategy for solving the problem: “There are 7 counters in all. I can see 5, so ... 6, 7. There must be two under the cover.”

## Part-Part-Whole

1. **Use a part-part-whole mat to create numbers.**

The part-part-whole mat helps children see that a number can be thought of in two parts. Select a number card (0–9) and place it on the dividing line of the part-part-whole mat. The number card indicates the “whole” that is to be made using counters. Invite students to explore different combinations of parts that can be combined to make the whole.



**2. Write equations to show how you make numbers.**

Help students through the following steps for each number card: 1) If the number card is nine, put nine counters on the mat with some in each section; 2) “read” the mat—*Three and six is the same as nine*; and 3) write an equation to represent the counters  $3 + 6 = 9$ .

**3. Explore different combinations of parts that make the same whole number.**

Keep a list of all the different number combinations that can be used to make each whole. If students do not list *0 + the target whole number* as a possible combination, point out that this is a valid combination as well.

**4. Look for patterns in the number combinations.**

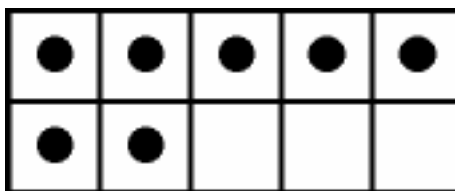
When students have found all the number combination for 2–9, encourage them to look for patterns. Help students to think of an organization such as:

2	3	4
1+1	1+2	1+3
2+0	2+1	2+2
	3+0	3+1
		4+0

## Make Ten

**1. Represent numbers with counters on a tens-frame mat.**

Show how numbers are represented on a ten-frame by first filling in the top row from left to right, and then the bottom row from left to right. Have students try representing a few numbers from 1 to 10.



**2. Add or remove counters from the tens-frame mat to show new numbers.**

Call out numbers from zero to 10. After each number, challenge the student to say “plus \_\_\_\_\_” or “minus \_\_\_\_\_” (whatever amount is required).

to change the student's ten-frame to show the new number). Ask them to add or remove counters to show the new number.

Example:

- ♦ Show 3 on the tens frame. Say 5. Student says, “plus 2” and then adds 2 counters to the mat to make 5.
- ♦ Leave the five counters on the mat. Say 9. Student says, “plus 4” and adds four counters to the mat to make 9.
- ♦ Say 3. Student says “minus 6” and removes 6 counters from the mat.

# More, Less, or Same?

# 3

## Overview

### Mathematical Focus

- ▶ Number relationships—more than, less than, equal to
- ▶ Sequencing of numbers

In this collection of sorting and ordering activities, students begin to make connections between the size of numbers and the counting sequence. They develop an understanding of the relative magnitude of numbers and of the relationships among whole numbers. Students sort dominoes and number cards into piles to show numbers that are *greater than*, *less than*, or the *same as* a target number. They create a variety of domino trains including a “one-more-than” train, a “two-more-than” train and a “one-less-than” train. Racko and Number Line provide opportunities for students to order numerals 1–20.

### Materials & Preparation

**Before the session, gather the following materials:**

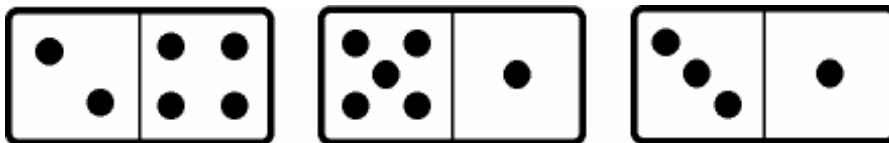
- ▶ Blank index cards; these will be used in Parts 1 & 6
- ▶ A dark color marker
- ▶ Student Page 4: Dominoes, 1 copy, cut out; or 1 set of dominoes blocks (optional)
- ▶ Student Page 2: Number Cards, 0–9, 4 sets, cut out
- ▶ Student Page 3: Number Cards, 10–20, 4 sets, cut out
- ▶ 5 foot piece of string
- ▶ Paperclips

In Part 1 of this activity, students make their own set of dominoes which are then used in Parts 2 & 3. If you wish to skip Part 1, you may use a set of domino blocks or dominoes cut out from Student Page 4: Dominoes for Parts 2 & 3 of the activity.

## Make-Your-Own Dominoes

### 1. Describe various dominoes.

Talk with students about dominoes. Using index cards, make a few sample dominoes and ask students to describe each one.



### 2. Make a set of dominoes.

Give students index cards and a marker. Ask them to make a set of dominoes that includes all of the combinations 0|0 to 6|6.

Ask: *How many dominoes do you think there will be in the set? How will you know when you've made them all?*

Encourage students to develop their own system for keeping track of all the possible combinations.

## Sort by Number

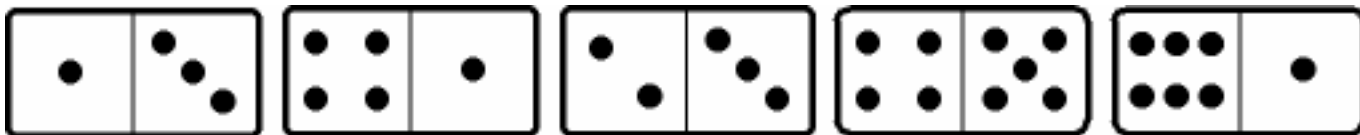
### 1. Sort dominoes by the number of dots shown.

One pile shows all the dominoes with six dots, while another pile would show all the dominoes with seven, and so on.

## Domino Trains

### 1. Make a “one-more-than” domino train

Take turns placing dominoes, each new domino should be placed so that the new square is one more than the last. Also try creating a “two-more-than” train or a “one-less-than” train.



## Target Number

### 1. Sort number cards by comparing sizes to a target number.

Shuffle a set of number cards, 0–10. Select a single card as the target and have students sort the remaining cards into three piles: those with more, less, or the same number of objects.

## 5 in Order

*2 players*

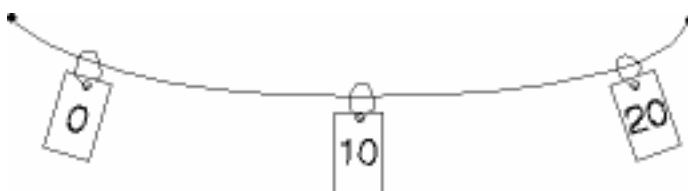
Use 2 sets of number cards, numbers 1–20. Each player is dealt 5 cards and places these face up in front of him or her in the order dealt. The remaining cards are placed face down to form the drawing pile. The top card is turned face up to start the discard pile. On a turn, a player takes a card from the stack or the discard pile and either exchanges it for one of his or her cards or discards it. The objective is to get and arrange 5 cards in order from the least to the greatest. Cards must stay in the order they are dealt. To make the game easier, limit the number of cards to 1–10 and use 3 sets of cards.

## Number Line

### 1. Locate numbers on a 0 to 20 number line.

Create a number line by laying a 5-foot piece of string on the floor. Use paperclips to attach the 0 number card at the left end of the string and the 20 number card at the right end of the string. Ask questions such as the following:

- ♦ *What number card should go in the middle of the number line? Why do you think so?* Place the 10 card in the middle of the string.
- ♦ *Can you show me about where the 15 card should go? The 8 card?* Try a few more numbers. Each time have students point to the approximate location of the number on the line and then assist them in clipping the card onto the string.



## **2. Locate numbers on a 5 to 15 number line.**

Take all of the cards off the number line. Change the cards clipped at either end of the number line. Put the 5 card on the far left and the 15 card on the far right. Ask the following questions and put the numbers on the line.

- ♦ *Which card should go in the middle?*
- ♦ *Where should we put the 10 card?*
- ♦ *What numbers should go between 5 and 10?*
- ♦ *Can you think of a number that is greater than 10 but less than 15? Clip the number to the number line.*

## **3. Answer questions about a number line with 10 in the middle.**

Take all of the cards off the number line. Clip the 10 card in the middle of the string. Ask:

- ♦ *What cards could we put at either end of number line? Are there other possibilities?*
- ♦ *What cards would go in between the 10 and the end number? The 10 and the first number? Clip cards on the number line where you think they should go.*

## **4. Create your own number line.**

Give students an opportunity to place number cards of their choice at either end of the number line and decide which cards go in between the two end numbers. Or have students place one card in the center of the line and determine which cards go on either side. Have blank cards available if students wish to make numeral cards for numbers greater than 20.

# Counting Strategies

## Overview

### Mathematical Focus

- ▶ Counting Strategies

Students explore a variety of counting strategies, such as skip counting by 2's, 5's, and 10's and counting backwards. As students investigate and use counting strategies, they develop a greater understanding of numbers and number relationships. They also build a basis for understanding the operations of multiplication and division.

### Materials & Preparation

**Before the session, gather the following materials:**

- ▶ Student Page 5: Number Line
- ▶ Student Page 6: 0–99 Chart

# Activity

## Skip Counting on a Number Line

### 1. Count by 2's to ten and then to twenty.

Ask students to use leaps on a 0–30 number line to count by 2's to 20. As students count aloud have them draw the leaps: “two, four, six . . .”



### 2. Count by 2's starting from different numbers.

For example, start at 15 and count by 2's. Ask questions such as:

- ♦ *Compare the distance between 0–2 and 15–17. Is it the same? [Emphasize that no matter where you start, if you are counting by 2's, the distance between numbers will always be 2.]*
- ♦ *Start at 0 count by two's. Start at 8 count by two's—what happens?*

### 3. Skip count by other numbers on a number line.

Suggest that students skip count by 3's, 4's, 5's, and 10's. Use 0 as the first starting point and then explore other starting points as well.

### 4. Think of things that come in sets of 3's, 4's, 5's and so on and make up problems involving these items.

Use skip counting on a number line to solve the problems.

## Counting on a Chart

### 1. Skip count by 2's to 50 on a Hundreds chart.

Each time students say a number, have them shade that square on the hundred's chart.

0	1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18	19
20	21	22	23	24	25	26	27	28	29
30	31	32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47	48	49
50	51	52	53	54	55	56	57	58	59
60	61	62	63	64	65	66	67	68	69
70	71	72	73	74	75	76	77	78	79
80	81	82	83	84	85	86	87	88	89
90	91	92	93	94	95	96	97	98	99

Ask questions such as:

- ♦ *What patterns do you notice in the shaded squares?*
- ♦ *If you were to continue counting by 2's to 100, would the same pattern continue?*

## 2. Count by 2's to 50 starting at 5.

Ask students to shade each number they say. Ask: *How is the pattern on the chart similar to or different from the patterns on the first chart?*

*Teaching Tip*

Students may begin to notice that, if you are counting by the same number, the shaded patterns on the chart are always the same. Encourage students to describe the shaded pattern for each chart they make. At first, students may have difficulty verbalizing the patterns they see; their descriptions may be imprecise. As you support them in their thinking, model appropriate terminology for describing the patterns, using words such as diagonal, checkerboard, and vertical columns.

## 3. Explore other types of skip counting on a chart.

- ♦ Count by 3's starting at 0. Predict whether or not the shaded pattern will look the same if you start at a different number.
- ♦ Count by 3's starting at 7. Compare the two charts.
- ♦ Predict what the shaded pattern on the chart will look like if you count by 5's. Count by 5's starting at 0. Count by 5's starting at another number. Compare the two charts.

- ♦ Encourage students to suggest additional counting explorations on the 0–99 chart.

## Buzz

*3 or more players*

Introduce the game of Buzz Five. Sit in a circle. The first person says “one,” the next person says “two,” and so on, until the number five is reached. Any number containing five or a multiple of five cannot be said. Instead, the word BUZZ is substituted. For example, a game of Five Buzz would be played as follows: One, two, three, four, BUZZ, six, seven, eight, nine, BUZZ, eleven . . . For 52, a player would say “Buzz” (52 contains a five); for 55, a player would say “Buzz, Buzz” (55 contains two fives). If a player says any number that contains a 5 or is a multiple of 5, he or she drops out of the game.

*Teaching  
Tip*

If students have difficulty playing Buzz, try playing the game with a chart. Players can follow along on the chart and more easily see upcoming Buzz numbers.

Try playing Buzz Two or Buzz Ten. Also try Backwards Buzz: start at 100 and count backwards, substituting the word Buzz for the target numbers or multiples of the target number. For more advanced players, extend the playing domain to Buzz Three or Buzz Four.

# Explorations on a Hundreds Chart

## Overview

### Mathematical Focus

- ▶ Number sense—number patterns, number relationships
- ▶ Computational strategies for addition and subtraction

The investigations in this activity give students an opportunity to explore number patterns on a chart. The chart provides visual support for developing number sense, as well as developing computational strategies for the operations of addition and subtraction.

### Materials and Preparation

**Before the session, gather the following materials:**

- ▶ Student Page 6: Chart (with dividers)
- ▶ Student Page 7: Blank Chart

For Part 2: Chart Puzzle, you will need a copy of Student Page 6: Chart. Cut the chart apart along the dark dividing lines to make a set of puzzle pieces. Put the pieces in an envelope.

For Part 4: Roll and Move, you will need a cube marked with the numbers, +10, -1, +9, -10, +1, +11 on each face.

# Activity

## Fill in the Chart

### 1. Make observations about the Hundreds Chart.

0	1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18	19
20	21	22	23	24	25	26	27	28	29
30	31	32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47	48	49
50	51	52	53	54	55	56	57	58	59
60	61	62	63	64	65	66	67	68	69
70	71	72	73	74	75	76	77	78	79
80	81	82	83	84	85	86	87	88	89
90	91	92	93	94	95	96	97	98	99

Ask questions such as:

- ♦ *What do you notice about the numbers on this chart?*
- ♦ *How is this chart different from a number line?*
- ♦ *How do you move to the next number when you get to the end of a row? For example, once you reach 9, how do you move to 10?*
- ♦ *What is the smallest number on the chart? The largest?*
- ♦ *What do you notice about the numbers in the columns?*

### 2. Finish filling in a Hundreds Chart that is missing numbers.

Partially fill in Student Page 7: Blank Chart, leaving holes all over the chart. Let students finish filling out the chart.

## Chart Puzzle

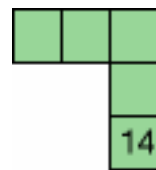
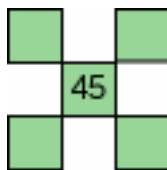
### 1. Put together the Chart Puzzle.

Give students a copy of Student Page 7: Blank Chart and the envelope with the cut-out chart pieces. Explain that you have taken a chart and cut it into pieces. Challenge students to reassemble the puzzle pieces on top of the blank chart. Ask questions such as: *What clues did you look for to put the puzzle back together?*

## Hundreds Chart Pieces

### 1. Fill in missing numbers on hundreds chart pieces.

Create a variety of hundreds chart pieces such as the ones below for students to fill in.



## Roll and Move

### 1. Move a marker around on a hundreds chart according to the roll of a number cube.

For this activity, which gives students experience moving around on a Hundreds chart, you will need a number cube (see Materials & Preparation note above), a marker (such as a penny), and a copy of Student Page 6: 0–99 Chart.

Have students place their marker at 50 on the hundreds chart. Invite them to roll the number cube and move their marker accordingly. Create a chart, such as the one below, for recording moves.

Roll	New Number
+10	60
-9	51

## Teaching Tip

Observe how students move between numbers. Do they count by ones to get to the next number? Do they use the “tens” shortcut to jump to the next row when they roll a +10 or a –10. Can they adapt the tens shortcut to create strategies for adding and subtracting the other numbers?

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Initially, students can just practice rolling the number cube and moving around on the chart. Once they are comfortable with this, Roll and Move can become a game for two or more players. The goal can be reaching a target number such as 100.

## Extension

Give students an opportunity to explore computation on a hundreds chart. Begin with an example, such as  $14 + 16$ . Show how to start at 14, move up a row to add 10, land at 24, then count on 6 to 30. Pose a variety of addition and subtraction problems for students to explore on the chart.

# Groups of Ten



## Overview

### Mathematical Focus

- Place value
- Operation sense—addition and subtraction of 2-digit numbers.

This activity provides students with experiences in modeling and naming numbers in different ways. Students strengthen their conceptual knowledge of place value as they develop flexibility in grouping and ungrouping by tens. The ability to mentally visualize and think about numbers in different ways contributes to children’s overall development of number sense.

### Materials & Preparation

**Before the session, gather the following materials:**

- 100–200 counters, such as Popsicle sticks, tongue depressors, or strips of paper.
- Rubberbands or paperclips for binding counters together.

# Activity

## Groups of Ten

### 1. Put counters into groups of ten.

Give students 100–200 counters to put into groups of ten. Each group of ten should then be bound together using a rubberband (or a paperclip if paper strips are used). Ask: *How many groups of 10 can you make? How many singles are left over?*

### 2. Represent numbers using groups of ten counters and single counters.

Write down numbers between 1 and 100 for students to represent with counters. Students may find it necessary to break apart a group of tens to have enough ones to represent a number.

Suggest challenges such as the following:

- ♦ *Use groups and singles to show three different ways of making 24. (24 ones; 1 ten and 14 ones; 2 tens and 4 ones)*
- ♦ *Chain problems: Start with 34, add 3 ones. Show the original number and the new number with counters (groups and singles), then write a number sentence to represent the problem:  $34 + 3 = 37$ . Continue the chain problem: take away 6 ones. Show  $37 - 6$  with counters; write:  $37 - 6 = 31$ . Continue the chain problem.*

## Circles

### 1. Estimate how many circles you can draw in a minute and then try it.

After making their estimates, students should try to draw as many circles as they can while you time 1 minute (circles should be separate from each other; no circles within other circles).

### 2. Group the circles into groups of ten by drawing large circles around each group.

Ask:

- ♦ *How many groups of 10 do you have?*
- ♦ *How many 1's?*
- ♦ *How many circles all together?*

Try the activity again and compare results. Switch roles: you be the drawer and the student is the timer. Try the activity drawing triangles.

# Building Numbers

## Overview

### Mathematical Focus

- Place value
- Problem-solving strategies

In this activity students explore place value concepts by investigating 2- and 3-digit numbers. They begin to recognize the importance of digits' positions in numbers. Through games and other investigations, students gain experience with the idea that digits have different values depending on their position in a number.

### Materials & Preparation

**Before the session, gather the following materials:**

- Student Page 2: Number Cards (0–9), 2 copies

# Activity

## Greatest Value

*2–4 players*

You will need 1 set of Number Cards (0–9) for each player.

Shuffle all of the cards and place the stack face down. Each player draws two number cards from a stack. The players arrange the cards to make a 2-digit number with the greatest value. The player with the highest 2-digit number wins that round. Play continues for six rounds. The player who wins the most rounds wins the game.

Play Greatest Value to create a 3-digit number with the greatest value.

*Teaching  
Tip*

Make sure students read both numbers aloud, compare them, and discuss why one number is larger.

## All the Numbers

- 1. Think of all the three-digit numbers that can be made with three digits drawn from the set of number cards.**

Shuffle 2 sets of Number Cards, 0–9, and place the stack face down so that students may draw three digit cards to use. Students should list all of the three-digit numbers that they come up with for a set of three digit cards in order from smallest to largest.

- 2. Write all the 1-, 2-, and 3-digit numbers that can be made using three digits drawn from the number cards.**

Ask the student to list the numbers in order from smallest to largest.



# Number Stories

## Overview

### Mathematical Focus

- ▶ Computation
  - ◆ addition & subtraction, 2-digit numbers, no regrouping
  - ◆ multiplication and division
- ▶ Problem solving

In this activity, students use a problem-solving approach to investigate and develop meaning for the operations of addition, subtraction, multiplication, and division. They use pictures, modeling, and counting strategies to represent and solve number stories. The number stories suggest a variety of problem-solving situations in which students must reason mathematically and cultivate their intuitive mathematical knowledge.

### Materials & Preparation

**Before the session, gather the following materials:**

- ▶ Counters
- ▶ Paper and crayons or markers

# Activity

## Addition & Subtraction Stories

1. Use objects or pictures to represent the addition or subtraction problem in each of the stories below.

For each story, ask questions such as:

- ♦ *What information do you know?*
- ♦ *How can you use objects or a picture to represent that information?*
- ♦ *What information do you need to find out?*
- ♦ *How can you use objects or counting to help you find the missing information?*
- ♦ *Can you make up another story for me to solve? [The story should end in a question and require addition or subtraction to be solved.]*

### A Day at the Beach

- ▶ Marie collected 5 starfish on the beach. Ingrid gave her 7 more. How many starfish does Marie have all together?
- ▶ 15 boats are in the harbor. Seven are tugboats and the rest are fishing boats. How many fishing boats are in the harbor?
- ▶ Marie and Ingrid went digging for clams. Marie got 13 clams and Ingrid got 6. How many more clams does Marie have than Ingrid?
- ▶ Carlos collected some shells on the beach. Marie gave him 5 more. Now he has 12 shells. How many shells did Carlos have to start with?
- ▶ Carlos collected some shells on the beach. He gave 3 to Marie. Now he has 9 shells left. How many shells did he have to start with?

### Teaching Tip

Support students in inventing their own strategies for representing and solving problems. Imposing a problem-solving strategy on students or telling them “tricks” for solving problems may only confuse them.

# Multiplication & Division Stories

## 1. Use objects or pictures to represent the multiplication or division problems in each story.

These stories give students opportunities to explore multiplication and division through situations such as equal groupings of objects and sharing equally. Support students' mathematical thinking, encourage them to explain their reasoning, and ask questions that will help students make sense of situations or look at them in a different way.

### How Many Feet?

- ▶ A family has the following pets: 3 dogs, 2 cats and a bird. How many feet and tails are there all together?
- ▶ How many feet are there in your family? How many toes? How many toes, fingers, and noses all together?

A blue rounded rectangle with a pink border containing the text "Teaching Tip" in a cursive font.

One strategy for solving this type of problem is to create equal groups with objects and then count the total number. Students might also use a skip counting strategy.

- ▶ In one family of people and pets there are 8 legs. There are also 2 wings. What combinations of people and pets are possible?
- ▶ In the still of the night, the family dog felt 3 spiders and 4 ants crawl across her. How many creeping legs did she feel all together? (spiders have 8 legs; ants have 6)
- ▶ Make up your own stories about feet, legs, arms, toes, fingers, noses, eyes, ears or heads. The story must end in a question and must require addition, subtraction, multiplication or division to be solved.

### Pizza Night

- ▶ Suppose that each person in your family is going to have 2 slices of pizza. The pizza shop sells only large pizzas with 8 slices. How many pizzas will you need to order? Will there be any left over?
- ▶ Suppose you invite some more relatives and friends to join you for dinner. Make a list of all the people who will come for dinner. How many pizzas will you need to order? Will there be any pizza left over after everyone has 2 slices?

## Teaching Tip

Give students time to think about how they will solve the problem. Let them choose their own materials for representing the problem. Observe their approach. As they are working, encourage them to explain their thinking strategies.

## Extension

Children's books can provide a wealth of opportunities for exploring computation in an engaging context. You may want to check out books from your local library such as the following:

*The King's Commissioners*, by Aileen Friedman, Scholastic Inc., 1994. After reading the story aloud to the students, return to the illustrated tally sheets and discuss with the students the various counting strategies. Have the students create their own commissioners and add them to the king's commissioners. The students should find and illustrate various methods of counting the total number of commissioners (the king's plus their own).

*Six Dinner Sid*, by Inga Moore, Simon and Schuster Inc., 1991. Read *Six Dinner Sid* aloud to the students, emphasizing that Sid had six dinners in ONE day. Ask the students to find out how many dinners Sid would have in seven days. For younger students ask how many dinners Sid had in two days, three days . . . and work them up to seven days. Students should explain their problem-solving strategies.

*The Shopping Basket*, by John Burningham, Candlewick Press, 1980. After reading the story aloud to the students, have them show a number representation of how many items Steven was going to buy. The students should then take turns writing number sentences for each time an item was taken from Steven's basket. Discuss with the students the different number sentences ( $21 - 2 = 19$  and  $20 - 1 = 19$  are both correct). Then the students should write and solve a word problem and a number sentence asking how many items Steven lost on his way home.

*A Bag Full of Pups*, by Dick Gackenbach, Clarion Books, Houghton Mifflin, 1981. After reading the story aloud to the students, have them represent the number 12 as parts (illustrations, tally marks, manipulatives). Students can also write number sentences to go with their representations. The students should then write number sentences that follow the text.

# Number Puzzles



## Overview

### Mathematical Focus

- ▶ Computation—addition and subtraction of 1- and 2-digit numbers, with regrouping
- ▶ Problem-solving strategies—estimation and reasoning

A variety of number puzzles are presented in this activity to give students experience adding and subtracting 1- and 2-digit numbers. Students also develop skill in using the problem-solving strategies of estimation and reasoning.

### Materials & Preparation

**Before the session, gather the following materials:**

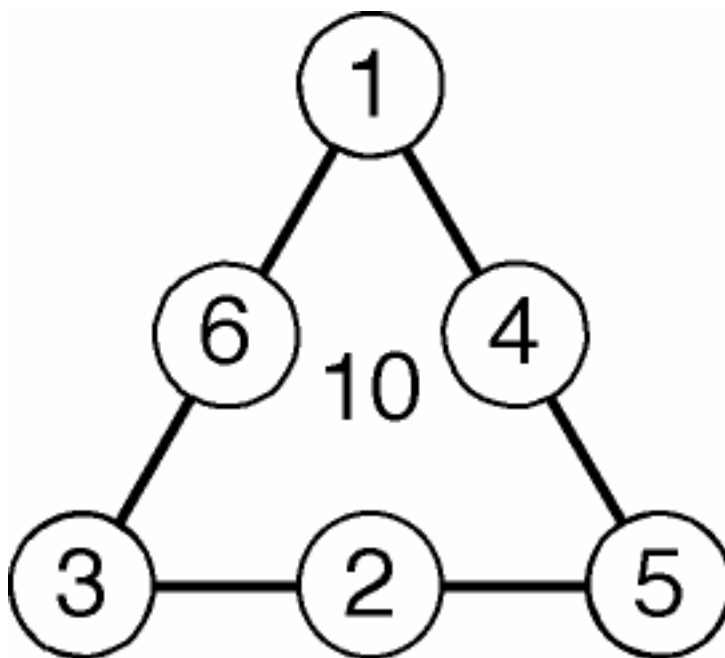
- ▶ Student Page 2: Number Cards, 0–9
- ▶ Student Page 3: Number Cards, 10–20
- ▶ Student Page 9: Number Triangles and Wheels
- ▶ Student Page 10: Diffy Board
- ▶ 1 die

# Activity

## Number Triangles and Wheels

1. Explore different ways of arranging the numerals 1-6 in the circles on the Number Triangle so that the sum for each side is the same as the target number in the center.

Write a target number in the center of the triangle on Student Page 9: Number Triangles and Wheels. Ask students to figure out how to put the numerals 1-6 in the other circles so that all sides add up to the center number. Ask about students' problem-solving strategies.



2. Use the numerals 1-9 and place them on the wheel so that each line adds up to the same number.

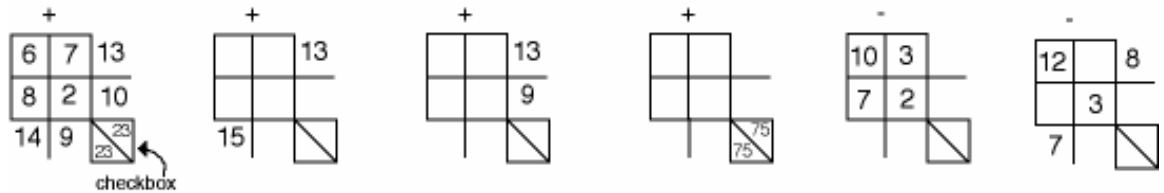
Each numeral may be used only once. Encourage students to explain the problem-solving strategies they used to solve the puzzle.

# Addition and Subtraction Squares

## 1. Solve addition and subtraction squares.

Make up addition and subtraction squares such as the ones below for students to solve.

NOTE: the square in the lower right corner is the checkbox.



Challenge students to complete addition squares by computing horizontal and vertical sums to find the missing values. The value for the checkbox can be found by computing the sum for the rightmost column and the bottom row. For subtraction squares, students compute the horizontal and vertical differences to find the missing values. The value for the checkbox can be found by computing the difference for the rightmost column and the bottom row. If the values agree, the student has solved the square successfully.

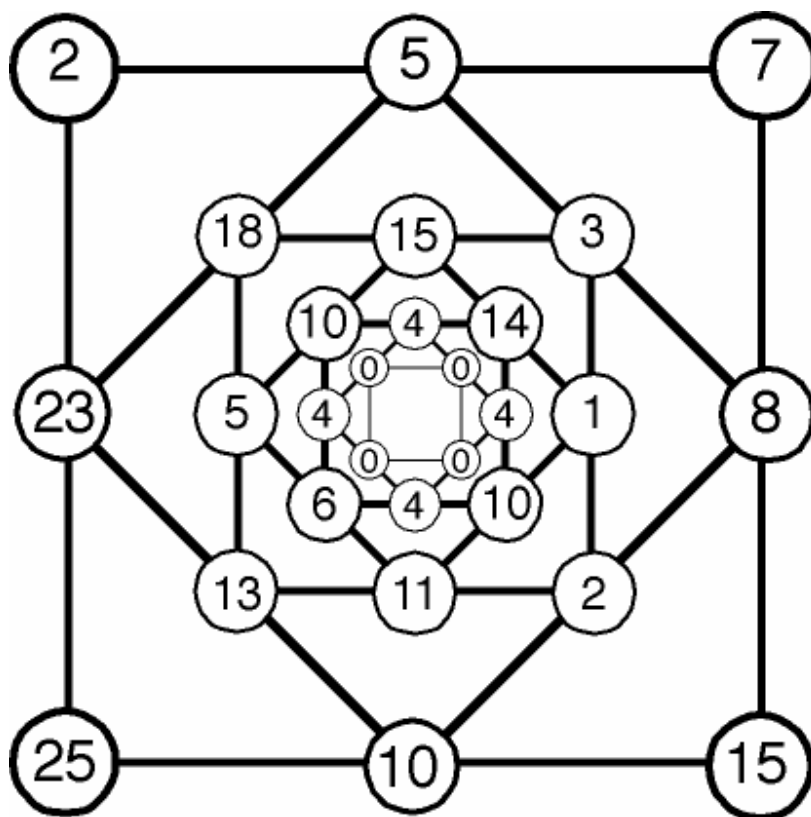
*Teaching Tip*

Explore with students why the two values in the checkbox should agree.

## Diffy

### 1. Write four numerals in the corners of a Diffy Board, complete the Diffy Board, and try to avoid writing zero before reaching the innermost square.

After writing four numerals in the corners, students can complete the Diffy Board by, 1) putting the difference between each pair of corner numerals in the circle between them, 2) using these new circles as the corners of the next smaller square – and writing the differences between each of these corners in their own center circles, and 3) continuing to find the differences while working toward the center. It takes 6 moves to reach the center. A sample completed Diffy Board is shown below.



## Mystery Numbers

### 1. Solve and create mystery number puzzles.

Present students with the following mystery: *I have two numbers. When I add them together I get 7. When I subtract them I get 1. What are my mystery numbers?*

*Teaching Tip*

One strategy for solving the mystery is to think of pairs of numbers that can be added together to make 7. For each pair, check to see if the difference between the numbers is 1. Make sure students understand that to find the difference between two numbers, they must subtract the smaller number from the larger number. Make a chart to keep track of the numbers that have been tried:

Add together to make 7		Difference of #'s 1?
5	2	(3) no
6	1	(5) no
4	3	(1) yes!

Make up additional mystery numbers for students to solve. You may also want to invite students to create their own mystery numbers. The process of creating a mystery problem can be just as valuable as solving one.

## Cross Out Singles

Each player draws a 3x3 square. Using a number cube or die, each player rolls 9 times and fills in each one of the cells in his or her square with the rolled number. The sum of the numbers in each row and column is calculated. Players get to keep any sums that have a partner; single sums are crossed out. The sums that are kept are then added together to obtain a final score. The player with the highest score wins.

In the example below, 11 and 10 have partners; 9 does not; therefore, the score would be:  $11 + 11 + 11 + 10 + 10 = 53$ .

5	2	4	11
3	5	2	10
3	2	5	10
11	9	11	

*Teaching  
Tip*

The first few times playing, students may not be aware that strategic placement of numbers can increase their score. After each game, give students an opportunity to rearrange the numbers to see if they can get a higher score.

# Add It Up!

## Overview

### Mathematical Focus

- ▶ Computation—addition and subtraction of 1- and 2-digit numbers

The number games presented in this activity provide students with experience in adding and subtracting 1- and 2-digit numbers.

### Materials & Preparation

**Before the session, gather the following materials:**

- ▶ Student Page 2: Number Cards, 0–9
- ▶ 2 dice

# Activity

## Windows Comparison

### 1. Fill in the windows with numbers to make a true comparison.

Shuffle a set of 0-9 number cards and place the stack face down. Draw the windows below with a *greater than* sign in between the two windows.

$$\boxed{\phantom{0}}\boxed{\phantom{0}} > \boxed{\phantom{0}}\boxed{\phantom{0}}$$

The goal is to fill in the windows to make the comparison true. Turn over number cards one at a time. Each time a card is turned over, that number is written in a pane. Once a number is written in a pane, it cannot be erased or moved. When the windows are full, determine if the comparison statement is true.

### 2. Rearrange the number cards to find different ways of making the comparison true.

Encourage students to explain their strategies.

## Windows Addition and Subtraction

### 1. Windows Addition

**Goal:** To make the largest sum.

**Players:** 1 or more

**Materials:** One set of 0-9 number cards shuffled and placed face down on the table; Each player draws this window:

$$+ \begin{array}{|c|c|} \hline & \\ \hline & \\ \hline \end{array}$$

**Instructions:** Turn over number cards one at a time. Each time a number card is turned over, that digit is written in a pane on the window.

*Remember:* You must write each digit in a pane as soon as the card is turned over; you cannot erase or move it. When the windows are full, calculate sums. Compare sums to see who made the largest value. Try rearranging digits to come up with a larger sum.

Teaching  
Tip

If students have difficulty doing addition with regrouping, keep the digit cards to 0–4 and use two sets of cards.

**Variations:** Once students are comfortable with making the largest sum, try changing the goal to making the smallest sum or to making a target number, such as 75.

## 2. Devise and discuss strategies for creating the largest sum.

Ask questions such as:

- ♦ *When the goal is to make the largest sum, what kind of digits do you want to place in the tens column? (large digits) What kind of digits do you want to place in the ones column? (small) If a 7 came up as the first digit, where would you place it? Why?*
- ♦ *Is there more than one way to get the largest sum?*

## 3. Discuss strategies for playing Windows Subtraction to find the largest difference, the smallest difference, or a target difference.

Ask question such as:

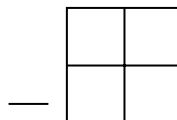
- ♦ *If the operation is subtraction and you want to make the largest difference, what will you need to do?*
- ♦ *If the operation is subtraction and you want to make the smallest difference, what will you need to do?*

## 4. Windows Subtraction

**Goal:** To make the largest difference.

**Players:** 1 or more

**Materials:** One set of 0-9 number cards shuffled and placed face down on the table; Each player draws this window:



**Instructions:** Turn over number cards one at a time. Each time a number card is turned over, that digit is written in a pane on the window.

*Remember: You must write each digit in a pane as soon as the card is turned over; you cannot erase or move it.* When the windows are full, calculate differences. Compare differences to see who made the largest value. Try rearranging digits to come up with a larger difference.

**Variations:** Play Windows Subtraction with the goal being to make the smallest difference or a target difference. After each game, ask if the

digits could be rearranged to make an even smaller number, or a number closer to the target number.

*Teaching Tip*

Students can get into negative numbers playing Windows Subtraction. To avoid negative numbers, let the goal be to get as close as possible to a target number, such as zero or another positive number.

## 5. Describe how Windows Subtraction differs from Windows Addition.

Students should see that in the subtraction games the result depends on which row you put your digits in as well as their placement from left to right.

# Number Games

## 1. Cover Up

**Goal:** To have the uncovered numbers that add to the smallest sum at the end of the game.

**Players:** 2 or more

**Materials:** 3 x 4 game boards for each player, 2 dice, small markers for covering numbers

**Instructions:** Players take turns rolling the dice. If they roll an 8, they may cover up 8 on their own game board or they may cover any way to make 8, such as 3 + 5 or 1 + 3 + 4. (Players must choose one way—not all ways.) Players continue until neither can cover a number that comes up on their own board. They add the numbers not covered on their own boards. The player with the smallest sum wins.

1	2	3	4
5	6	7	8
9	10	11	12

*Teaching Tip*

A calculator is a good tool for adding scores because the numbers can be difficult to add.

## 2. Make 4 Concentration

**Goal:** To find groups of cards that add to 4.

**Players:** 1 or more

**Materials:** 20 number cards showing the numeral and the number of dots—4 of each number 0–4

**Instructions:** The cards are shuffled and placed face down, in four rows with 5 cards in each row. Each player turns any cards over one at a time to get numbers that add up to four. If the cards add up to four, the player takes all the cards turned over. If the cards total more than four, then all the cards are turned face down again and it is the next player's turn.

**Variations:** Play using other target sums from 5-18.

### 3. Tic-Tac Add to 15

**Goal:** To get a row, column, or diagonal to add to 15.

**Players:** 2 or more

**Materials:** A tic-tac-toe board (3x3).

**Instructions:** One player used the numbers 1, 3, 5, 7, 9, and the other player uses the numbers 2, 4, 6, 8. Each number may be used only once. Players take turns writing numbers in the boxes. A player may block an opponent by putting a number in a square to make it impossible for that row to add to 15.

# Quick Ideas

## Overview

A collection of quick ideas for number explorations is presented below. Each number exploration can be used individually, for example, as a 10 minute warm-up at the beginning of a session, or several explorations can be used together as the activity for an entire session.

## Here's the Answer!

Write down a number. That number is “the answer.” Create several problems for which that number is the answer. Calculations can focus on addition, subtraction, multiplication, or division. Example: The answer is 6. Possible problems for which 6 is the answer:  $3 + 3$ ;  $2 \times 3$ ;  $12 \div 2$ .

## Arithmetic Stories

Create and illustrate a story for  $4 \times 5$  or for  $24 \div 3$ . Write additional problems focusing on addition, subtraction, multiplication, and/or division. Make up a story to go with each problem, and illustrate each story.

## Largest Number

Use a deck of playing cards (without the face cards) or 2 sets of Number Cards (0–20). Deal out all of the cards. The cards are placed face down in front of the players and at the same time they turn over the top card. Whoever turns over the card with the greater value wins both cards. If the two cards have the same value, “war” is declared. Each player places 3 cards face down and a fourth card face up. Whoever turns over the high card this time wins all the cards. Play continues until one player wins all the cards or until a time limit has expired. Later on, try playing with a deck of cards numbered 1–100.

## Tic-Tac Add to 15

Draw a tic-tac-toe board (3 x 3). The object is to get a row, column, or diagonal to add to 15. One player uses the numbers 1, 3, 5, 7, and 9, and the other player uses the numbers 2, 4, 6, and 8. Each number may be used only once. Players take turns writing numbers in the boxes. A player may block an opponent by putting a number in a square to make it impossible for that row to add to 15.

## Mystery Number Detective Stories

Use detective stories to emphasize concepts that students need additional practice with. Take turns creating and solving detective stories such as the following:

- ▶ *Clue 1:* If you start at 5 on the number line and count by 4's, you'll reach the mystery number.
- ▶ *Clue 2:* The mystery number is odd.

- ▶ *Clue 3:* If you start at 0 on the number line and count by 3's, you'll reach the mystery number.  
(The mystery number is 21.)

## Mental Chain Computation

Give students chain problems to solve step-by-step. Explain that there will be several steps and you only want the final answer. For example: Start with 2. Double it. Double that number. Subtract 5. What's the answer? Make sure you remember the starting number so that you can go back over the students' computations. Students may want to check their answers using a calculator.

## Concentration

Play the game of Concentration as a way of working on particular skills that students need extra practice with. For example, if students are having difficulty with number facts to 10, create cards like:

$1 + 0$	$0 + 1$	$1 + 1$	$2 + 0$
---------	---------	---------	---------

Students can match the number statements with totals or with equivalent statements:

$6 + 2$	and	$3 + 5$	$6 + 2$	and	$8$
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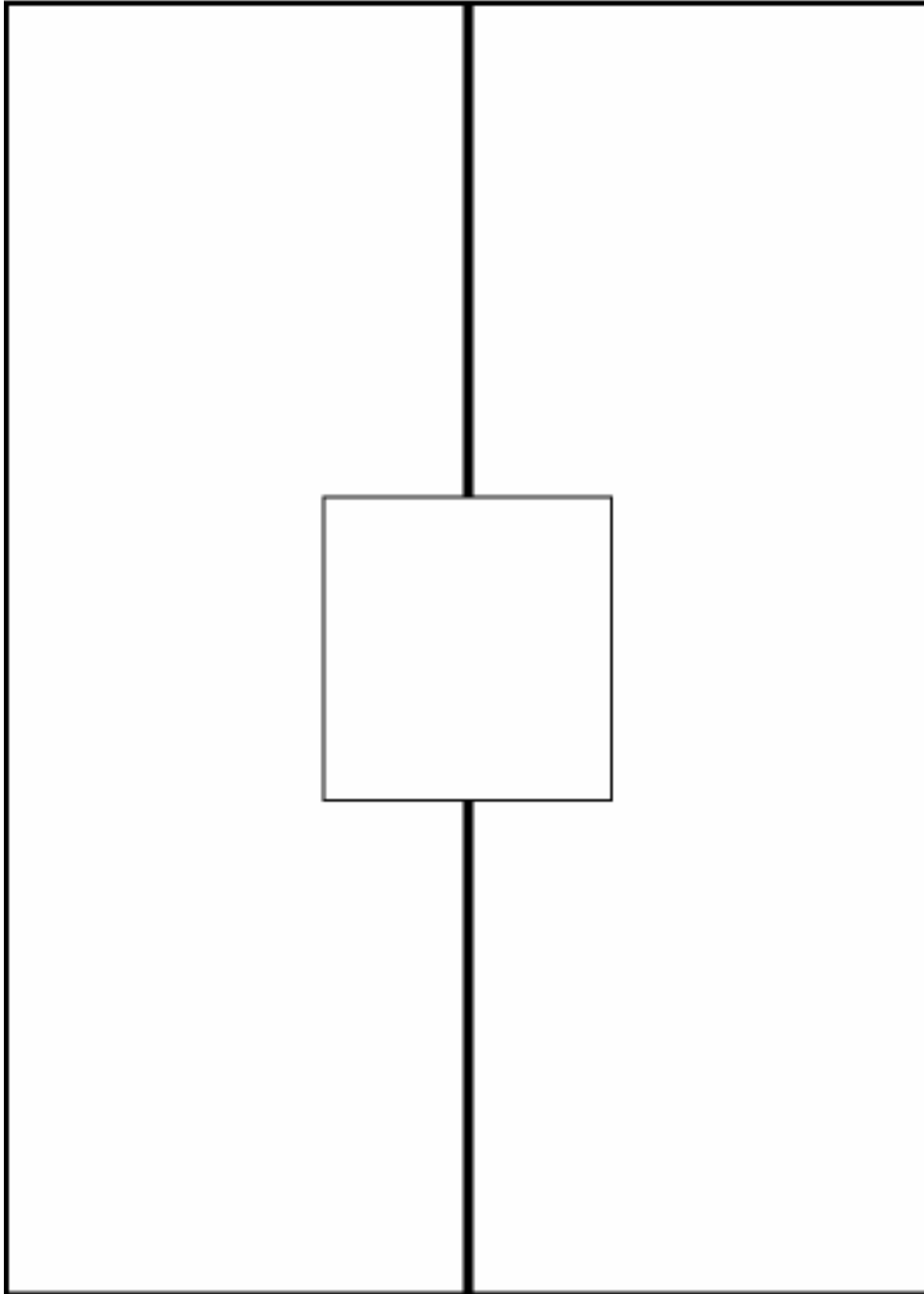
## Match

Make sure the deck includes several possible matches. Have students work with you to make the decks of cards. This will give them additional practice.

To play Concentration, the cards are shuffled and placed face down, in four rows with 5 cards in each row. Each player turns two cards over at the same time. If the cards match, the player keeps the cards turned over. If the cards do not match, it is the next player's turn.

# Part-Part-Whole Mat

*1*



# Number Cards, 0–9

2

0	1	2	3	4
---	---	---	---	---

5	6	7	8	9
---	---	---	---	---

# Number Cards, 10–20

3

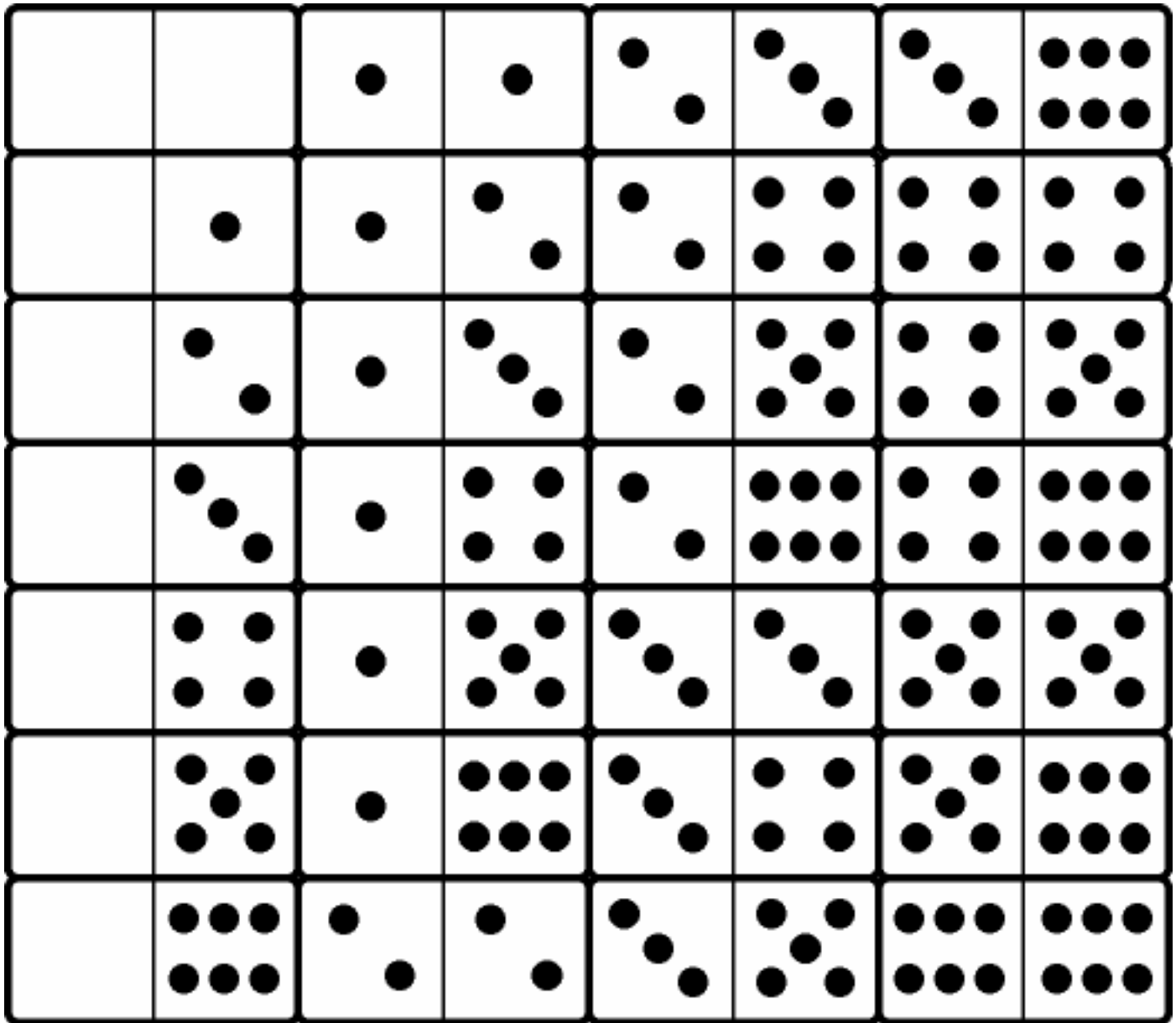
10	11	12	13	14
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15	16	17	18	19
----	----	----	----	----

20
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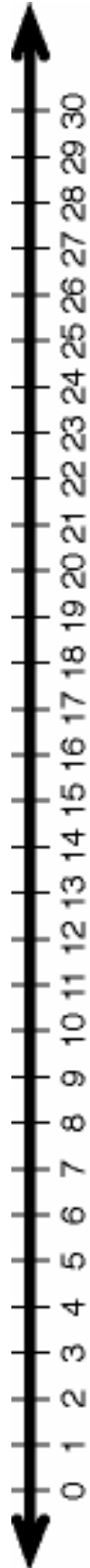
# Dominoes

4



# Number Line, 0–30

5



# 0–99 Chart

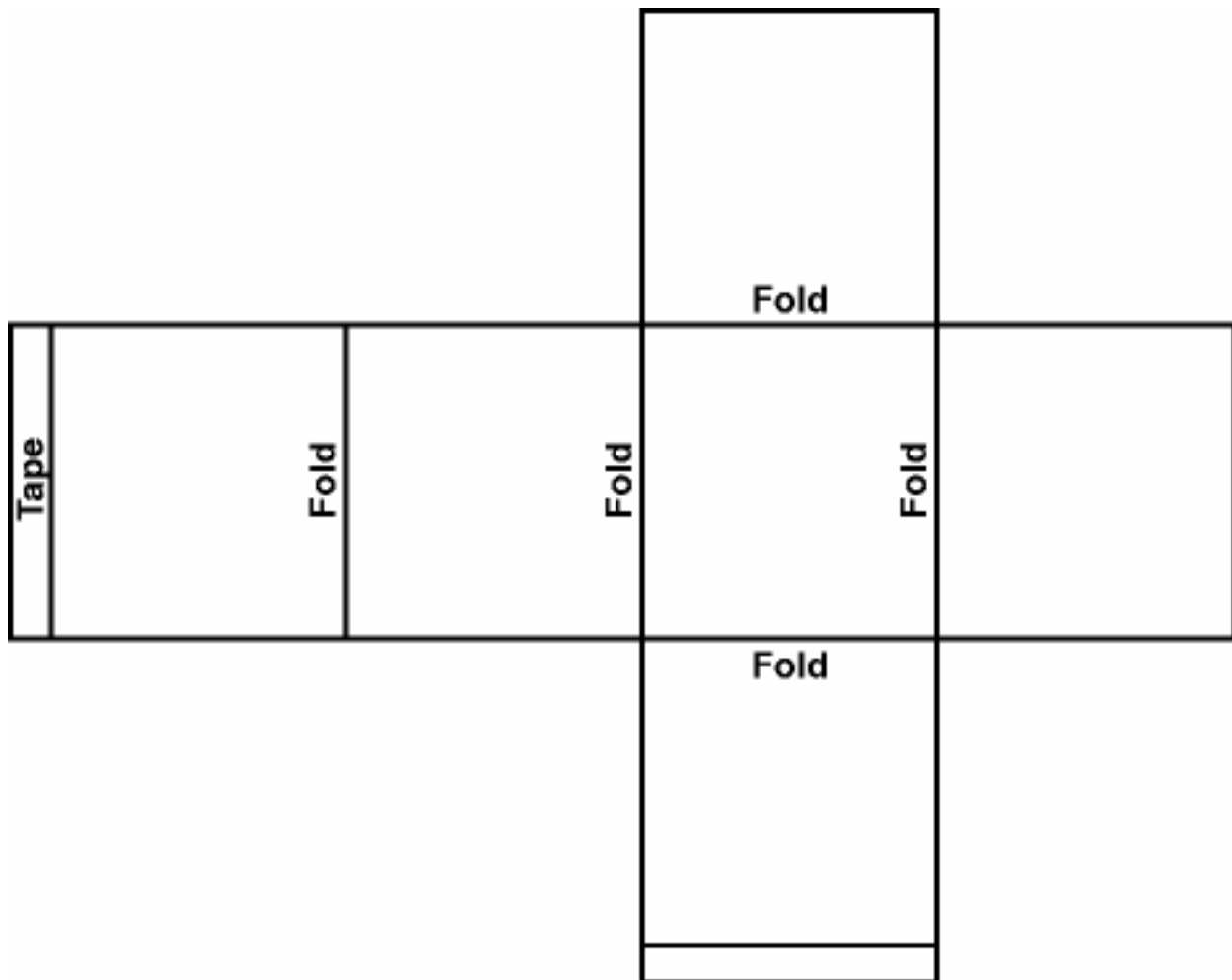


0	1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18	19
20	21	22	23	24	25	26	27	28	29
30	31	32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47	48	49
50	51	52	53	54	55	56	57	58	59
60	61	62	63	64	65	66	67	68	69
70	71	72	73	74	75	76	77	78	79
80	81	82	83	84	85	86	87	88	89
90	91	92	93	94	95	96	97	98	99

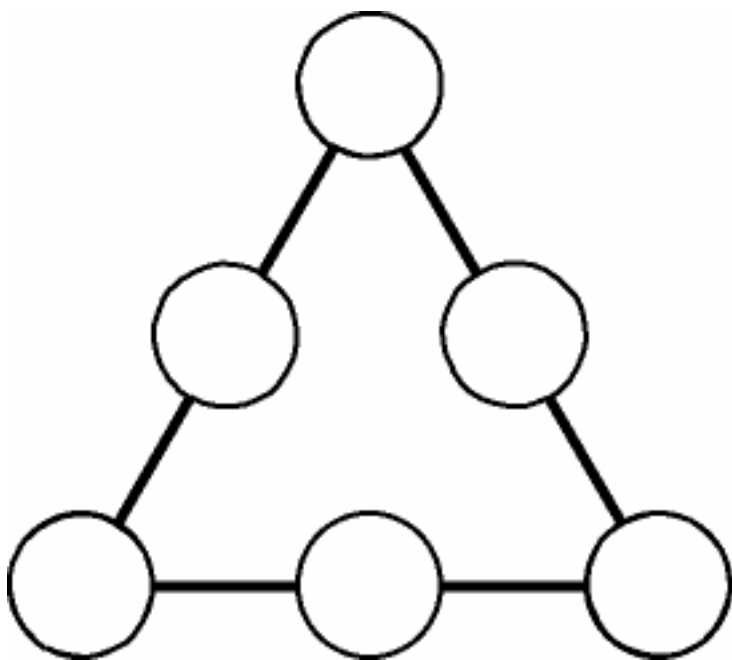
# 0–99 Chart (blank)




# Net for a Number Cube



# Number Triangle and Wheel

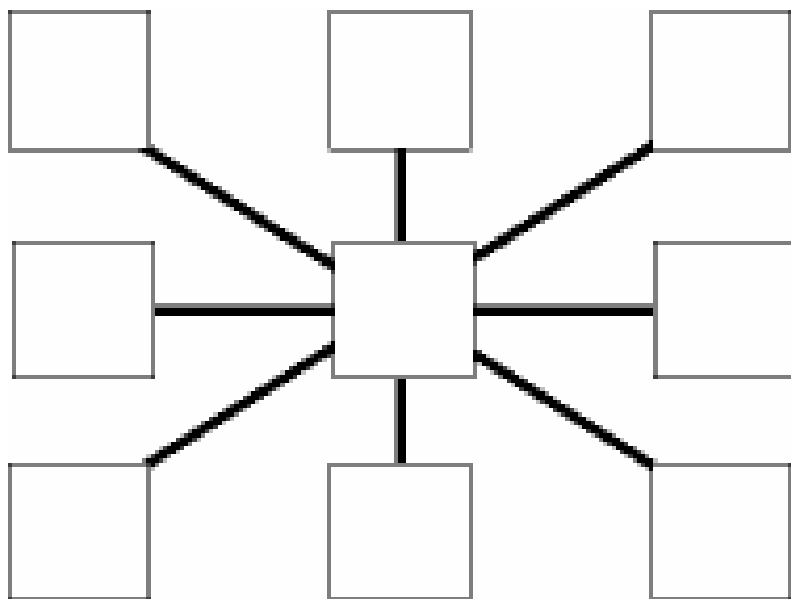


## Number Triangle

Arrange the numerals 1–6 in the circles so that the sum for each side is the same. Try making the sum 10. Try 11, 12, etc.

## Number Wheel

Use the numerals 1–9 and place them on this wheel so that each line adds to the same number. Use each numeral **once**.



# Diffy Board

10

