Fill Five

2 players

Counting on one, two, or three

Purpose

This game reinforces the count-on-1, -2, and -3 strategy for addition. Dot arrangements are used to help students progress from simple count-all strategies. In this game the highest possible sum is seven.

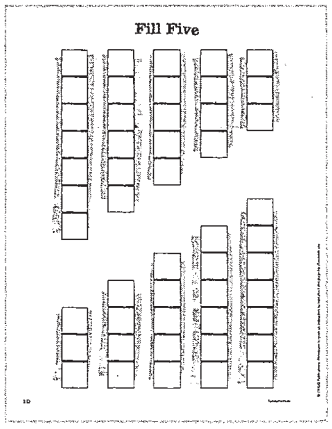
Materials

Each pair of players will need

- A 'Fill Five' game board (page 10) as shown below.
- Two (2) number cubes made from blank wooden cubes. Each cube should show domino dot patterns to represent 1, 2, 3, 1, 2, and 3.
- One (1) number cube showing the numerals 2, 3, 4, 2, 3, and 4. This can be made from a blank wooden cube.

Each player will need

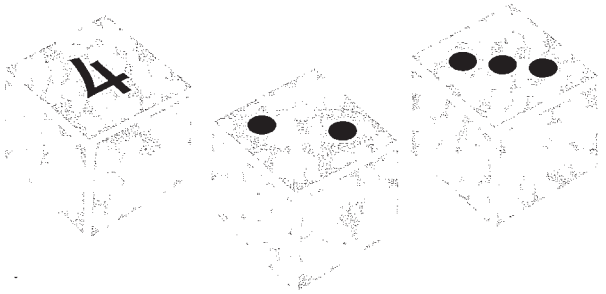
- Thirty (30) counters or linking cubes (fifteen each of two colors).



How to Play

The aim is to fill five trains with counters or linking cubes.

- Players sit at opposite ends of the game board.
- The first player rolls all three number cubes and chooses one dot cube to add to the numeral cube to make a number that fills a train on his or her end of the game board.



Example: Bianca rolls 4 on the numeral cube and 2 and 3 on the dot cubes. She can make 6 (4 + 2) or 7 (4 + 3).

- The player fills the matching train on his or her end of the game board, using counters or linking cubes of two different colors to show the two numbers combined. If both matching trains have been filled, the player misses a turn.
- The other player has a turn.
- The first player to fill all five trains is the winner.

Reading the Research

Studies have shown that first graders, including those who are learning disabled or do not speak English as their first language, may calculate single-digit sums more readily if they are taught counting-on strategies in a conceptual way (Fuson & Secada, 1986; Fuson & Fuson, 1992).

Before the Game

Gather the students on the floor around the game board. Demonstrate the rules by playing a game with a volunteer as your opponent. After each roll of the number cubes, calculate the total aloud by starting with the numeral and counting on the number of dots. In this way, the players will always count on 1, 2, or 3.

During the Game

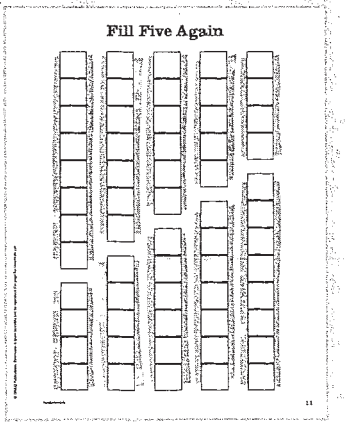
Look for students who count out the first number then count on the second. These students are using an inefficient count-all strategy. Encourage them to say the greater number first then count on the second number to obtain the total.

When a player has one 'empty' train remaining, ask questions such as, ***What numbers could you roll to give that total?*** Elicit several responses. Do the students understand that there is more than one solution? Can they give all the combinations including those that are not possible with these number cubes? For example, a student who needs a total of 6 may say, ***I could get 3 and 3 or 4 and 2, but I can't get 5 and 1, because there is no 5.***

Ask students to roll the numeral cube first then ask what they would like to roll on the dot cubes to obtain the number they need.

After the Game

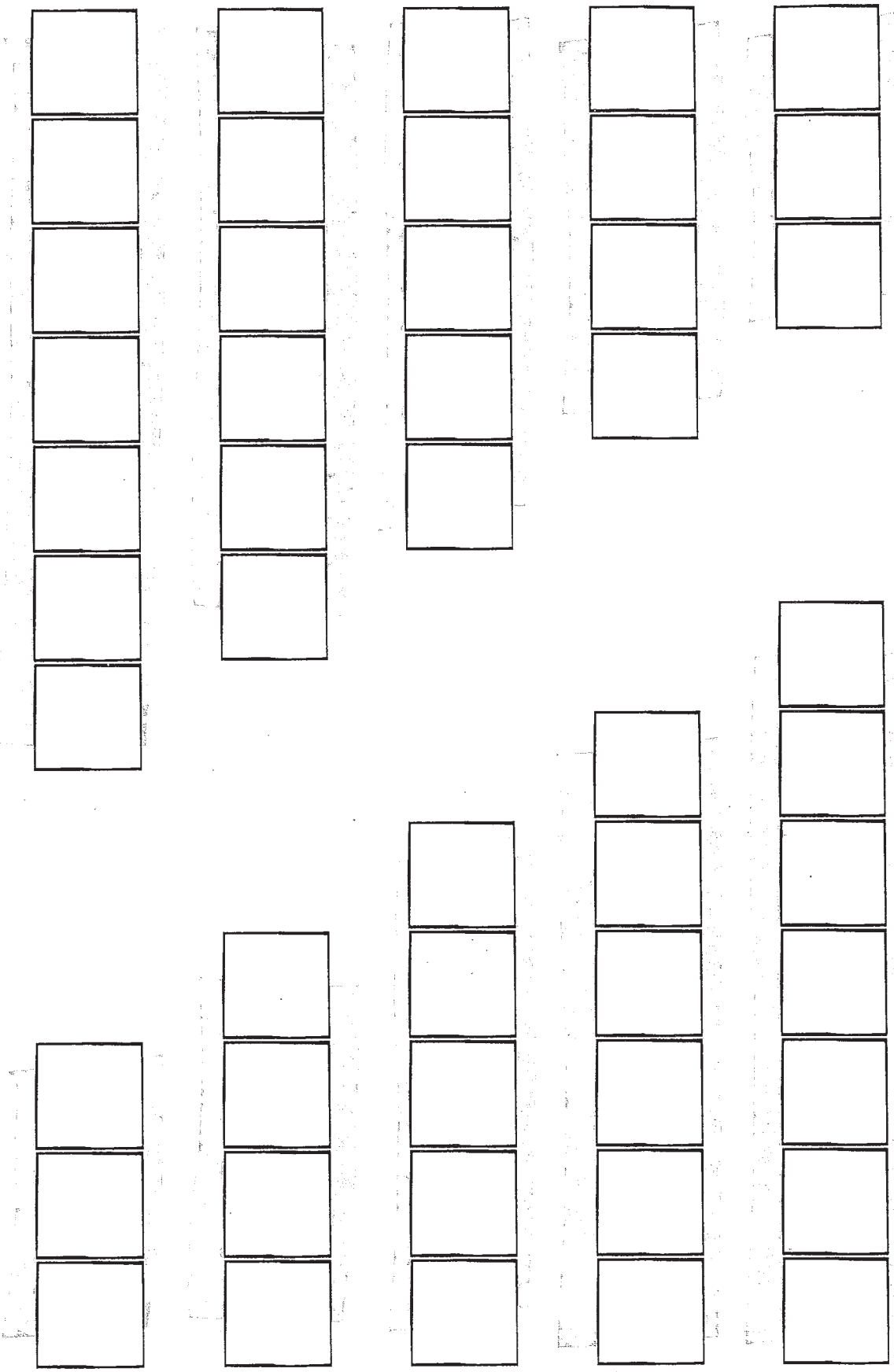
Call upon the students to say some numbers that are less than thirty but greater than ten. Write these on the faces of a blank cube. Roll the cube together with a dot cube from the game. Invite the students to calculate the total, for example, ***I rolled 14 and have 2 more. What is 14 plus 2?*** Encourage those students who gave a correct answer to share how they figured it out. Repeat this questioning for other rolls. Put the cubes away and ask similar questions about numbers less than thirty that are not on the cube, for example, ***If I had 24 and I got 3 more, how many would I have in all?***



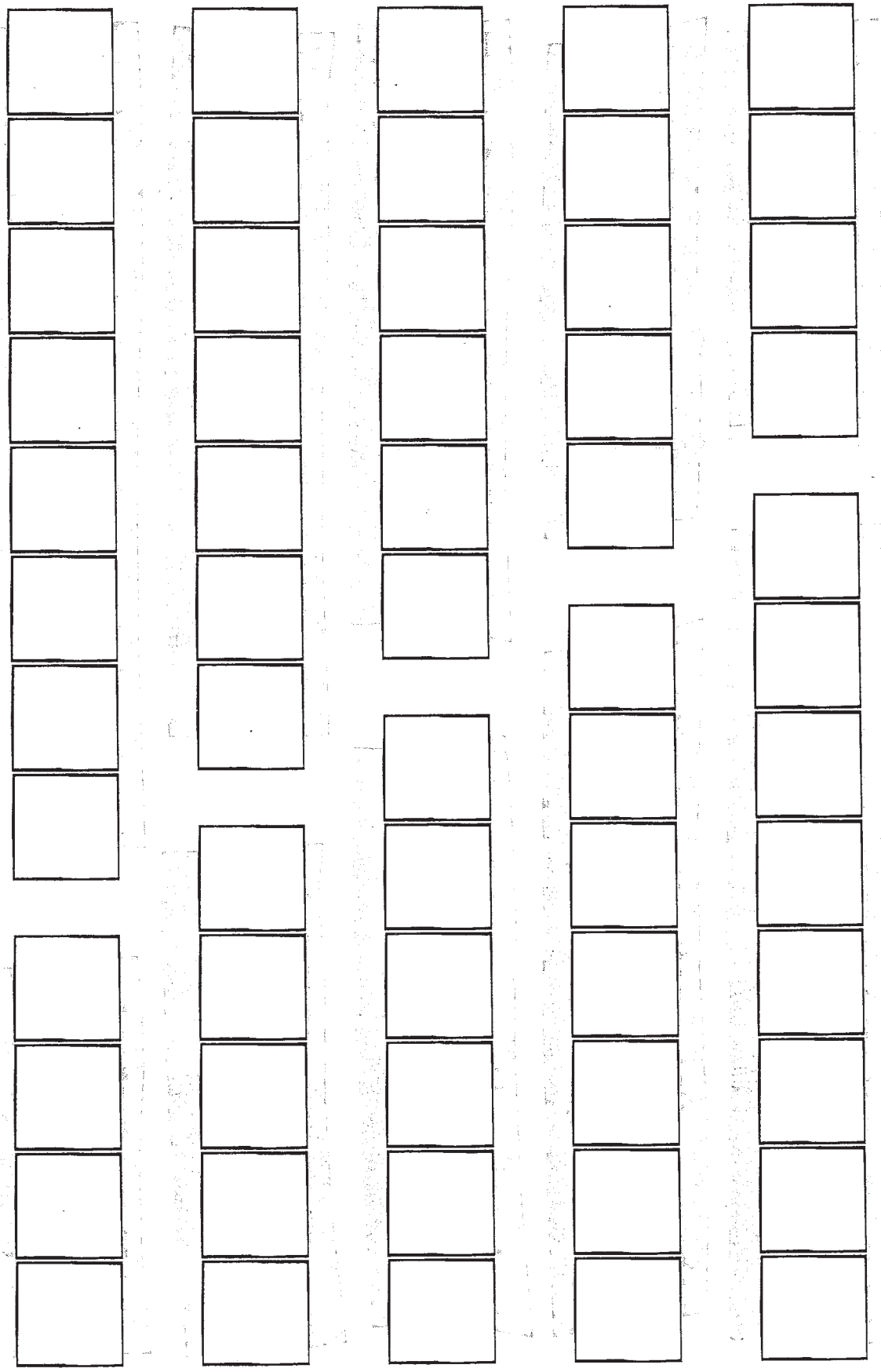
Beyond the Game

The students can play 'Fill Five Again' using the game board on page 11 (illustrated). In this game, the highest possible total is eight. The players need the dot cube from the previous activity and another number cube made from a blank wooden cube showing the numerals 3, 4, 5, 3, 4, and 5.

Fill Five



Fill Five Again



Nearby Numbers

2 players

Counting on/back one or two

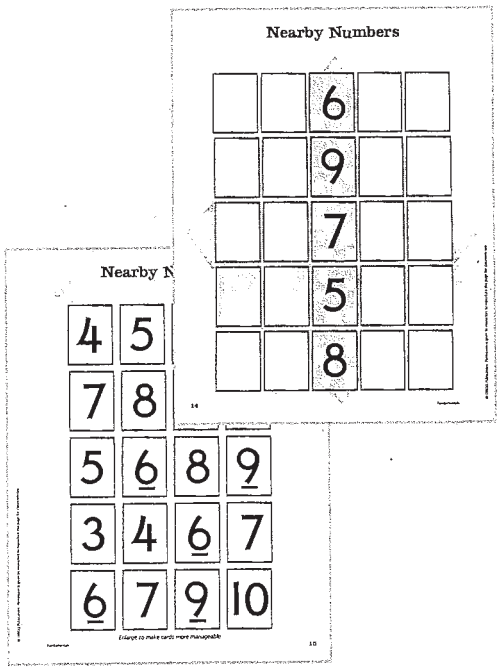
Purpose

This game reinforces mental strategies for addition and subtraction. More specifically, students are required to count on and count back 1 or 2 to given numbers.

Materials

Each pair of players will need

- A 'Nearby Numbers' game board (page 14) as shown below.
- One (1) set of numeral cards. Copy page 15 as shown below. Cut out and laminate the cards to make one set.



How to Play

The aim is to collect the greater number of cards by completing correct counting sequences.

- The cards are shuffled and dealt face down into two equal stacks.
- The first player draws the top card from his or her stack and positions it correctly in one of the incomplete counting sequences on the game board.

  Example: Sam draws a card showing 6. He can place it in the third, fourth, or fifth sequence.

- The other player has a turn.
- The player who completes a correct counting sequence by placing the last card in that sequence removes all the cards in that row.
- These cards are turned over and added to the bottom of the player's stack.
- The player with the greater number of cards after a given time is the winner.
- Alternatively, a player loses the game when he or she has no cards remaining.

Reading the Research

Encourage students to share their thinking. Studies indicate that peers can help each other to progress from using simple 'count-all' strategies to more efficient strategies (Noddings, 1985).

Before the Game

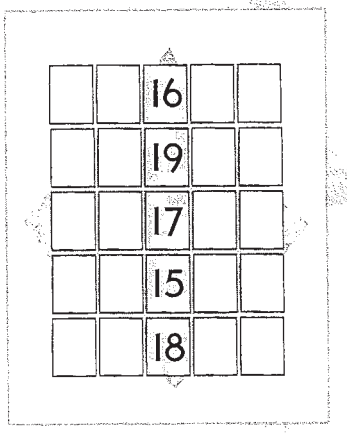
Make transparencies of the 'Nearby Numbers' game board and numeral cards. Explain and demonstrate the rules of the game on the overhead projector, then divide the class into two teams. Invite a representative from each team to play the game on the overhead projector. The representatives can call upon other members of their team to offer suggestions for where to place cards.

During the Game

Watch for students who find 'the number before…' and 'the number after…' by counting from one. These students are not using mental computation to solve the problem because they have not yet realized that the counting sequence is a chain that can be broken. You may be able to find other students to model strategies, such as using a known fact. For example, a student may say, *I can put a 7 here because 5 plus 2 equals 7.* Ask questions such as, *Where are all the spaces 9 could be placed? How do you know?*

After the Game

Invite the students to share strategies they used to win the game. For example, a student might say, *When I saw there was more than one space to place a card, I always placed it in the row that had less cards.* Also, some students may have noticed that there is only one numeral card for 3 and for 11. Although this means that there is only one space for 3 or 11, it also means that either of these could easily be the last card used to complete a sequence.

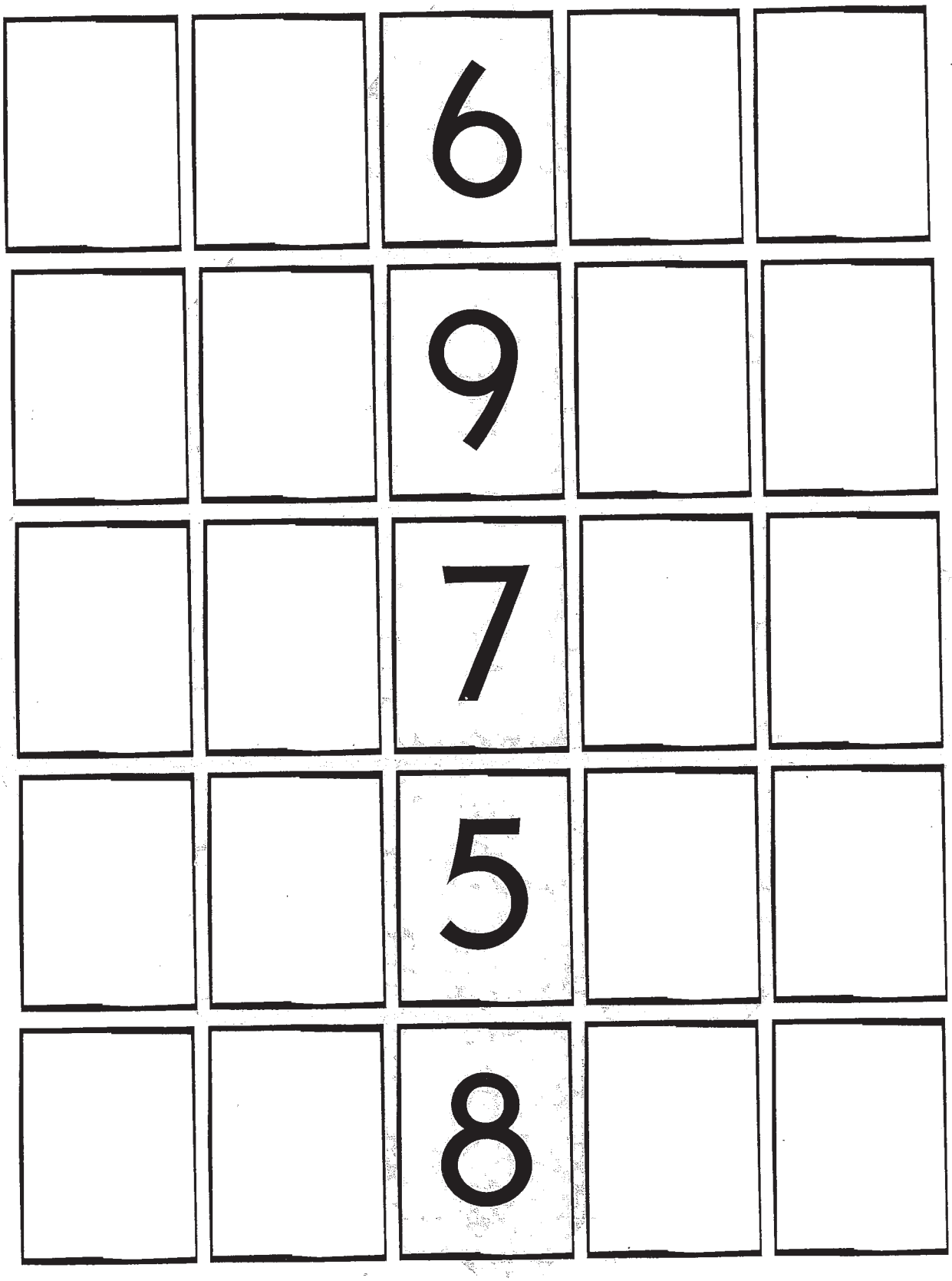


Beyond the Game

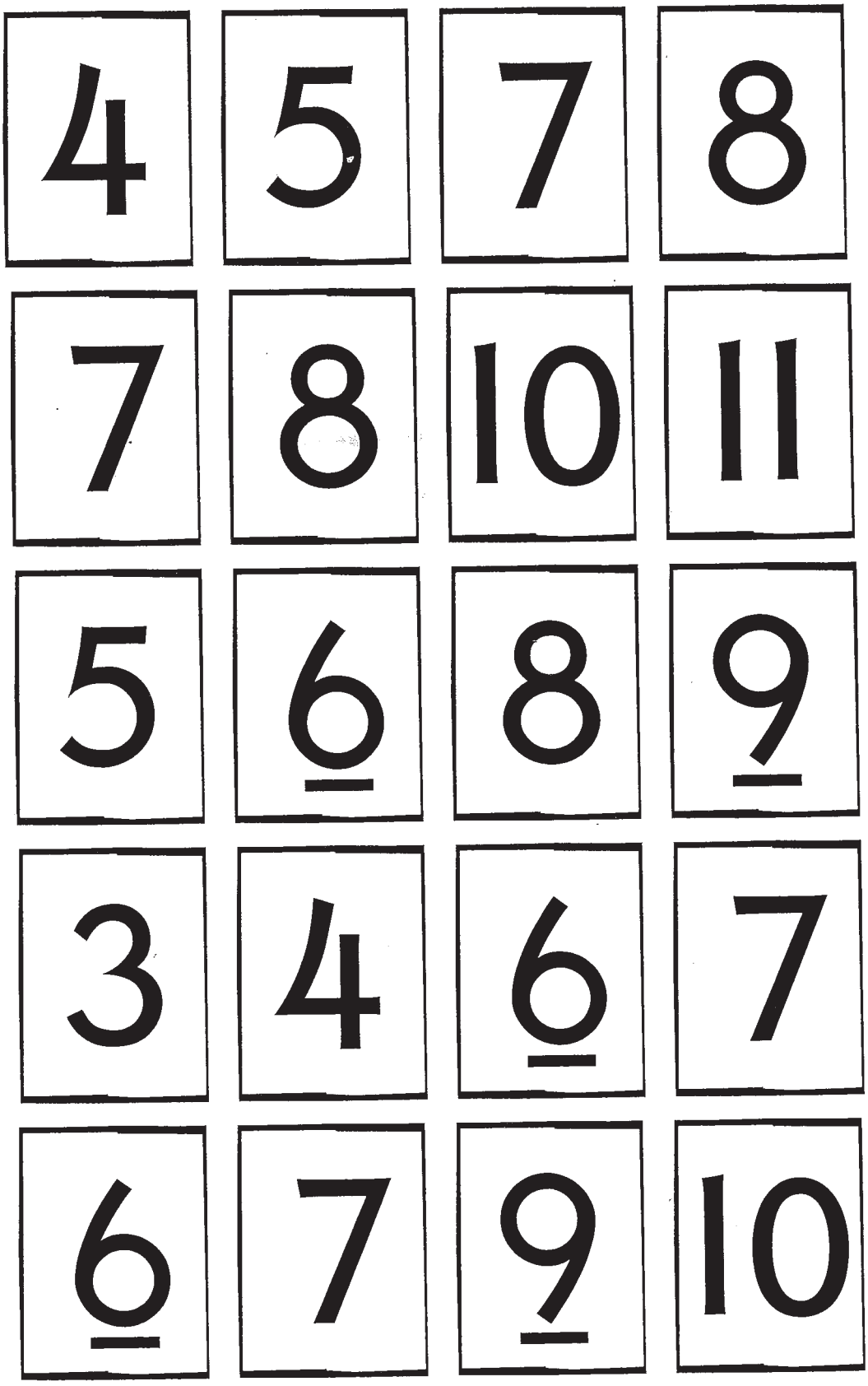
- Make a new game board as illustrated (left) to include the 'teen' numbers. One set of numeral cards (as shown below) will be needed. The rules are the same.

15	16	18	19	16
20	21	13	14	17
17	17	18	19	20
16	14	15	17	18

Nearby Numbers



Nearby Numbers



How Much More?

2 players

Finding the difference

Purpose

In this game, students find the difference between two numbers less than seven. Manipulatives are used to help students see that the difference can be calculated by taking away the part that is the same.

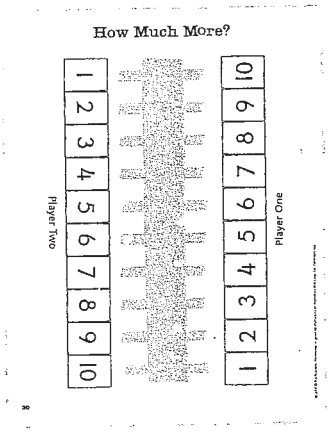
Materials

Each pair of players will need

- A 'How Much More?' game board (page 30) as shown below.
- Forty (40) linking cubes.

Each player will need

- One (1) standard, number cube showing dot patterns 1-6 (one color for each player).



How to Play

The aim is to collect ten linking cubes.

- Simultaneously, the players roll their number cubes.
- The player with the greater number calculates the difference between the two numbers rolled. If both players roll the same number, the difference is zero and the players roll again.

  Example: Donald rolls 6 and Emma rolls 3. Donald calculates a difference of 3 and says, I have 3 more.

- The players check the difference by making a train of linking cubes to match each number rolled.
- The players place the trains side-by-side and the difference is again stated. If the player with the greater number is correct, he or she collects the difference and places these linking cubes on his or her side of the game board. If the player calculates incorrectly, the other player collects the difference.

  Example: Donald makes a train of six linking cubes and Emma makes a train of three linking cubes. Donald states the difference again. As he is correct, he removes the difference (three cubes) and places them on his side of the game board.

- The first player to collect ten linking cubes is the winner.

Reading the Research

Children who use hands-on materials when learning mathematics generally achieve greater results than those who do not (Sowell, 1989; Suydam, 1986).

Before the Game

Before introducing the game, lead a discussion to compare two numbers. For example, write 6 and 4 on the board and ask, *What do you know about these numbers? How are they the same? How are they different?* If students say that one number is bigger than the other, ask, *How much bigger?*

Invite two students to play the game on the floor. The remainder of the class can sit or stand in a circle around the players and watch the game.

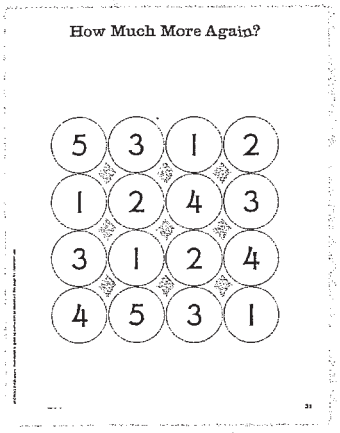
During the Game

Ask students to explain their mental computation strategies. Are they counting up from the smaller number or counting down from the larger number? Some students may be using other strategies, such as using doubles or near doubles.

Refer to the game board and ask questions such as, *How many more cubes do you need to make 10? How many more (or less) do you have than your opponent?*

After the Game

Ask questions such as, *What is the greatest number of cubes you could collect in one turn? How?* (It is possible to score 5 if one student rolls 6 and the other rolls 1.) *How could you score one?* (The players could roll 6 and 5, 5 and 4, 4 and 3, 3 and 2, or 2 and 1.)


How Much More Again?

5 3 1 2
1 2 4 3
3 1 2 4
4 5 3 1

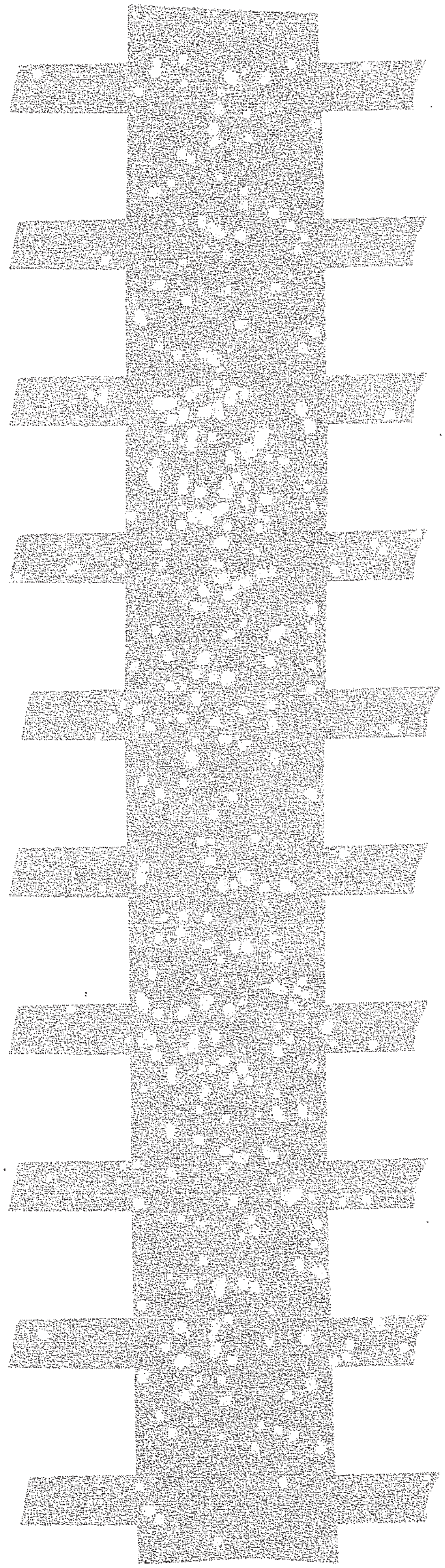
Beyond the Game

- Have the players use standard number cubes that show numerals 1-6. This will encourage them to move beyond 'counting dots' to calculate each difference.
- The students can play 'How Much More Again?' on the game board shown on page 31 (illustrated). Each player will need eight (8) counters of one color. The aim is to arrange three counters adjacently in a horizontal, vertical, or diagonal line. For example, if a player scores a difference of two, he or she places one counter on an available 2. For each move, players must decide to build a line or block their opponent. The first player to make a line of three adjacent counters is the winner.

How Much More?

Player Two

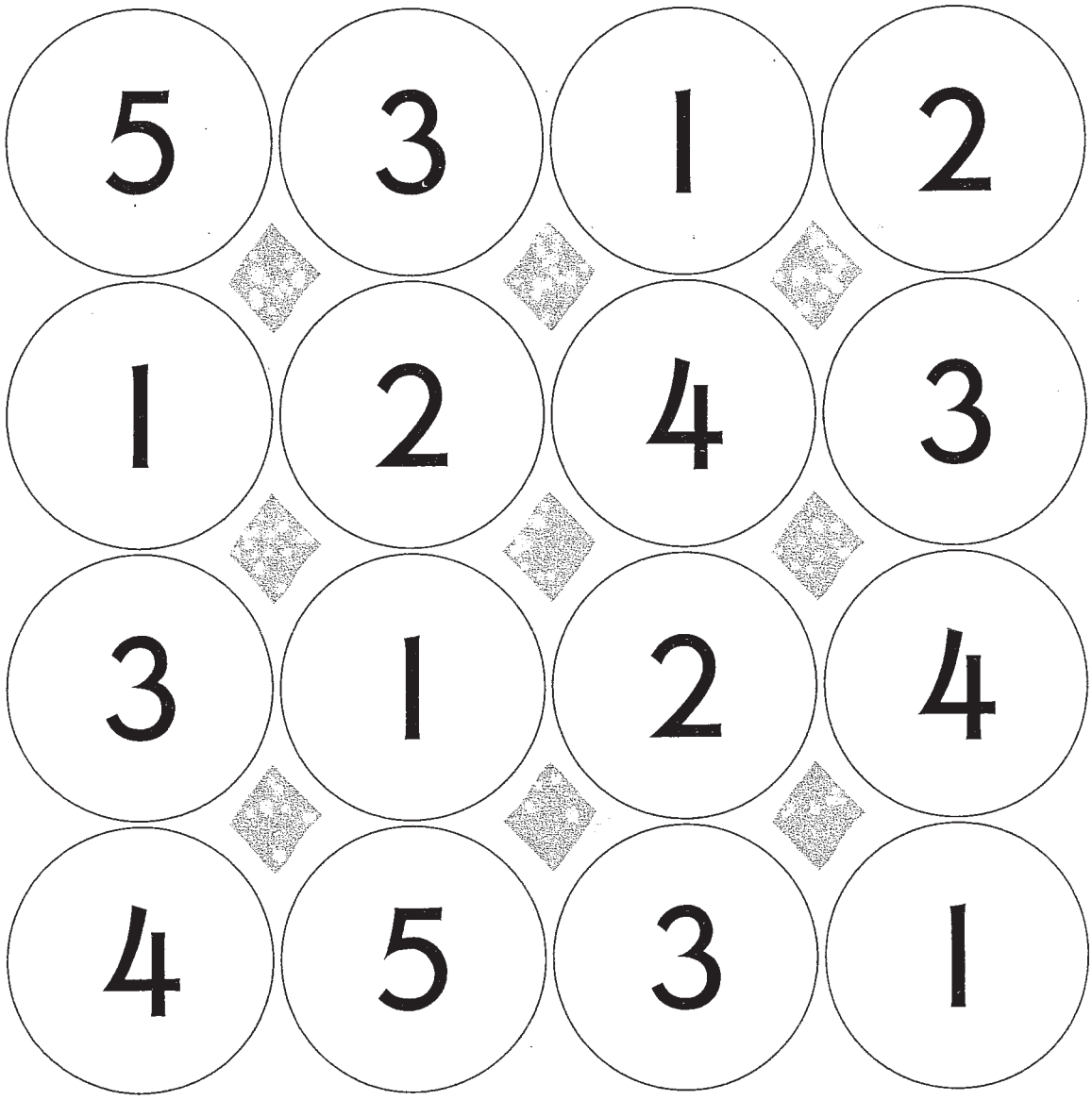
1
2
3
4
5
6
7
8
9
10



Player One

1
2
3
4
5
6
7
8
9
10

How Much More Again?



Total Twenty

2 players

Making combinations of twenty

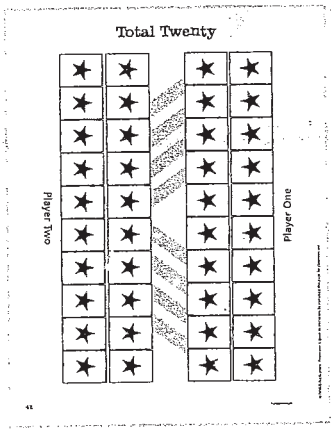
Purpose

This is an extension of the 'Total Ten' game described on pages 16-19. Not only does it build knowledge of the different combinations of twenty, in doing so, it also strengthens students' understanding of the 'teen' numbers. For example, the game board helps them visualize 16 as being 10 and 6 more.

Materials

Each pair of players will need

- A 'Total Twenty' game board (page 42) as shown below.
- One (1) standard number cube showing numerals or dot patterns 1-6.
- A bucket of counters in different colors.

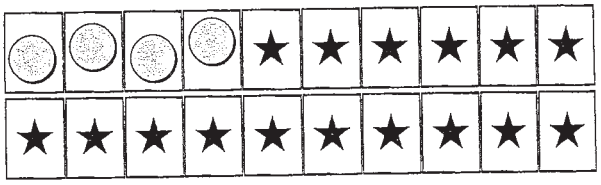


How to Play

The aim is to arrange twenty counters on the game board.

- The first player rolls the number cube, says the number, and places that number of counters on his or her side of the game board.

  Example: Ken rolls 4 and, starting from the left, he places four counters on the game board as shown below.



- The other player has a turn.
- Play alternates with players using counters of a different color for each turn, until one player fills his or her game board. If a player rolls a number that is 'too big' to complete the game, he or she misses a turn.

  Example: Debbie has 15 counters on the board. She can roll 1, 2, 3, or 4, and place that number of counters on the game board. She can roll 5 and win. If she rolls 6, she misses a turn.

- The first player to complete his or her game board is the winner.

Reading the Research

For students in grades K to 2, learning to see the part-whole relations of addition and subtraction situations is one of their most important accomplishments in arithmetic (National Research Council, 2001b).

Before the Game

Demonstrate the game on the overhead projector. Make sure students understand that they must fill their game boards from the top left and that the top row must be full before any counters are placed in the bottom row. This will reinforce the idea that a 'teen' is ten plus another number less than ten. At various times, ask students how many more are needed to total twenty.

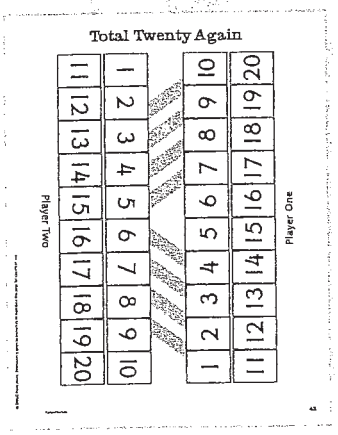
During the Game

As you move around the class, watch for students who are about to place counters in the second row. For example, suppose a student had a score of 8 and rolled 4. Can that student see that 8 + 2 = 10, plus another 2 will total 12?

Look for students who have filled more than their top line and ask questions such as, *How many counters do you have in all? How do you know?* The responses will vary, but some students may say, *I know I have 14 because I have 10 in the top row and 4 in the bottom row – that's 14 in all.* Follow responses such as this by asking how many more they need to total twenty.

After the Game

Ask questions such as, *If I have 10 and I get 3 more, how many will I have in all?* Get two students to demonstrate the 'teens' with their fingers. One student holds up ten fingers. The other holds up less than ten fingers. Ask the class how many in all. Reverse the question by asking for two volunteers to come to the front of the class and show a teen number, for example seventeen. Ask, *How many more to make 20?*

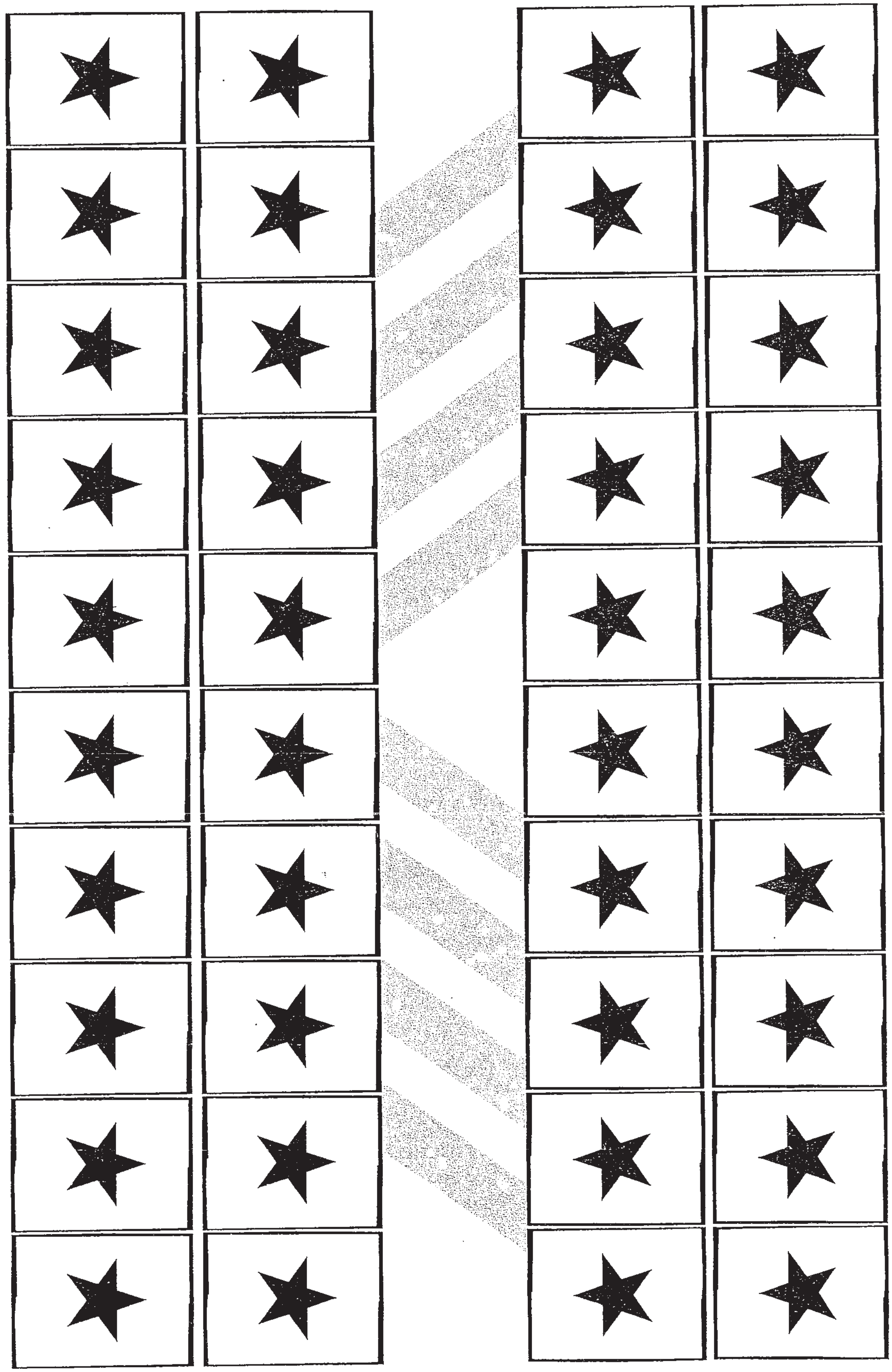


Beyond the Game

- The students could play 'Total Twenty Again' on the game board numbered 1-20 on page 43 (illustrated).
- Play the subtraction version of the game. The players start with twenty counters on the board. In turn, players roll the number cube and remove that number of counters starting from the bottom right-hand end of the board. When a player has completed such a move ask, *How many counters do you have left?*

Total Twenty

Player Two



Player One

Total Twenty Again

Player Two

11	12	13	14	15	16	17	18	19	20
1	2	3	4	5	6	7	8	9	10

Player One

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20

Add 'em Up

2 players

Adding two-digit numbers

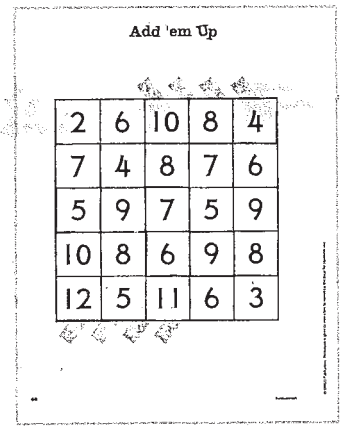
Purpose

In this game, students are encouraged to discuss various mental computation strategies for adding two single-digit numbers. Dot arrangements are used to help students progress from simple count-all strategies to more efficient strategies, such as counting on and using doubles or near doubles.

Materials

Each pair of players will need

- An 'Add 'em Up' game board (page 46) as shown below.
- Two (2) standard number cubes showing dot patterns 1-6.
- Twenty-four (24) counters (12 of one color for each player).



How to Play

The aim is to arrange four counters in a 2 x 2 square or adjacently in a horizontal, vertical, or diagonal line.

- The first player rolls the number cubes and mentally calculates the total of the two numbers rolled.
- The player then claims the answer on the game board by covering it with a counter. If the answer is unavailable, the player misses a turn. Several numbers appear more than once on the game board so players must decide which moves may be more advantageous for building winning patterns or for blocking opponents.

Example: Mia (yellow counters) rolls 3 and 6. The game board below shows she needs 9 and 6 to win. However, her opponent only needs 9 to win. Mia decides to block her opponent.

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

- The other player has a turn.
- The first player to make a 2 x 2 square or a line of four adjacent counters is the winner.

Reading the Research

Children use a small number of strategies for addition, but teachers can learn to identify them and help children develop procedures that are conceptually more efficient, for example counting on from the larger addend rather than counting all (Carpenter, Ansell, Franke, Fennema & Weisbeck, 1993; Fuson, 1992).

Before the Game

Introduce the game by asking two students to play on the overhead projector. Each student could play for one half of the class. Members of each team may offer strategies for calculating the total and suggest where to place the counter on the game board.

During the Game

Identify those students who calculate the total by counting from one. Pair these students with others who use strategies like counting on or using doubles. This will encourage them to explore the possibilities of more efficient strategies.

When a student needs only one number to form a line or square, stop the game and ask 'open' questions such as, *What number do you need to make a square? How could you get it? Is there another way?*

After the Game

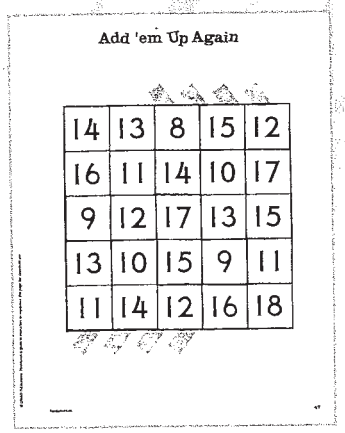
Challenge the students to figure out all the possible totals if one of the cubes is showing one. Investigations like this often generate further questions such as, *Which numbers are rolled the least often? ... most often? What are the possible combinations?*

Make an overhead transparency of the standard patterns shown on number cubes. Reveal two number cubes at a time. Encourage the students to share and explain strategies for calculating the total. For example, the numerals 5 and 4 may generate a discussion such as this:

Samuel: *I just start at the 5 and count four more: 6, 7, 8, 9.*

Sally: *I did it like this. 5 plus 5 equals 10 so 5 plus 4 must be 9.*

Silas: *I know double 4 equals 8, so 4 plus 5 must be 9.*



Beyond the Game

- The students could play 'Add 'em Up' using two standard number cubes showing numerals 1-6.
- The students can follow the same rules using the 'Add 'em Up Again' game board on page 47 (illustrated). The players will need one number cube showing numerals 7-12 and one standard number cube showing dot patterns 1-6. This version of the game is ideal for students who are consistently counting from one to find the total. It encourages the students to start with the greater number and count on the smaller amount.

Add 'em Up

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

Add 'em Up Again

14	13	8	15	12
16	11	14	10	17
9	12	17	13	15
13	10	15	9	11
11	14	12	16	18

Three Sum

Adding three single-digit numbers

2 players

Purpose

This game uses dot arrangements to help students progress from simple count-all strategies to more efficient strategies such as using doubles or making a ten. The students are encouraged to discuss various mental strategies for adding three single-digit numbers.

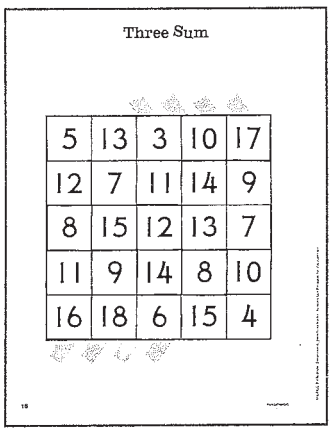
Materials

Each pair of players will need

- A 'Three Sum' game board (page 18) as shown below.
- Three (3) standard number cubes showing dot patterns 1-6.

Each player will need

- Twelve (12) counters (a different color for each player).


Three Sum

5	13	3	10	17
12	7	11	14	9
8	15	12	13	7
11	9	14	8	10
16	18	6	15	4

How to Play

The aim is to arrange four counters in a 2 x 2 square or adjacently in a horizontal, vertical, or diagonal line.

- The first player rolls the number cubes and mentally calculates the total of the three numbers.
- The player then claims the answer on the game board by covering it with a counter. If the answer is unavailable, the player misses a turn. A calculator can be used if an answer is disputed. Several numbers appear more than once on the game board so players must decide which moves may be more advantageous for building winning patterns or for blocking opponents.
- The other player has a turn.
- The first player to make a 2 x 2 square or a line of four adjacent counters is the winner.

Reading the Research

The teacher should not be disappointed if a student does not adopt more efficient strategies right away – development may be advancing below the surface at the rate best suited to the student (Isaacs & Carroll, 1999).

Before the Game

Introduce the game by inviting two students to play on the overhead projector using transparent counters. Each student could play for one half of the class. Members of each team can offer strategies for calculating the total and suggest where to place the counters on the game board.

During the Game

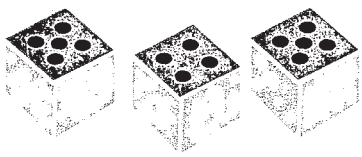
Identify those students who calculate the total by counting all of the dots or consistently use count-all strategies. Pair these students with others who use more efficient strategies. This will encourage them to explore the possibilities.

When a student needs only one number to form a line or square, stop the game and ask 'open' questions such as, *You need 11 to make a square. How could you get it? Is there another way?*

After the Game

Challenge the students to figure out all the possible totals if one of the cubes is showing the numeral one. Investigations such as this often generate further questions, for example, *Which numbers are rolled the least often? ... most often? What are the possible combinations?*

Make an overhead transparency of page 19. Reveal three number cubes at a time. Encourage the students to share and explain strategies for calculating the total. For example, the first picture may generate a discussion such as this:



Jessica: *I know that 5 + 4 = 9, so I count on 5 more. 9 ...10, 11, 12, 13, 14.*

Jack: *You don't have to do that. There are 2 fives, so that's 10, and 4 more makes 14.*

Jacinta: *Yes, and if there was a dot in the middle of the 4 it would be 3 fives, or fifteen, so the answer must be 14.*

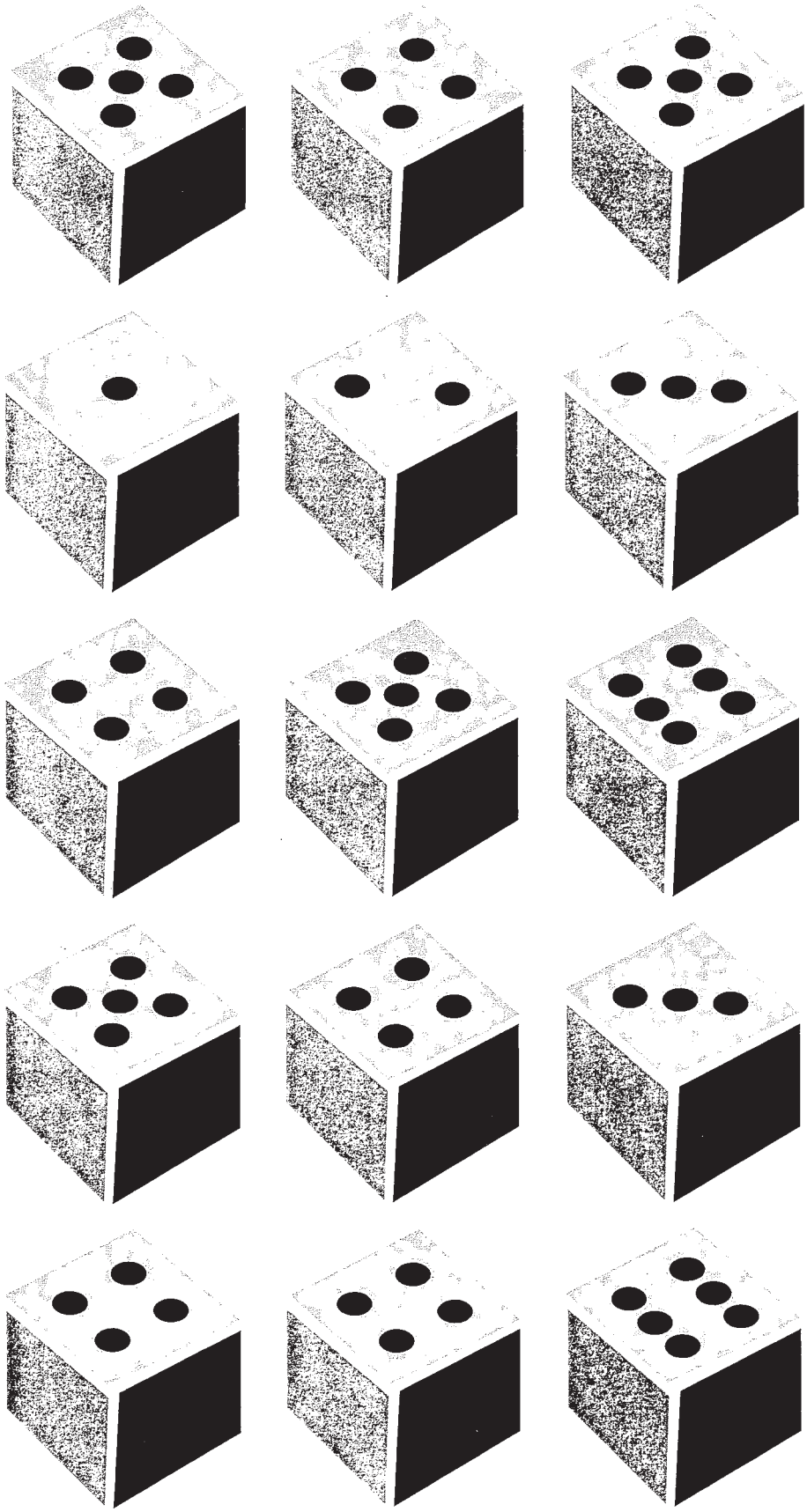
Beyond the Game

- The students can play the game using cubes that show numerals 1-6.
- Have the students make their own number cubes that show the other one-digit numbers, for example, numerals 4-9. They will also need to generate all possible combinations for their number cubes to make a matching game board.

Three Sum

5	13	3	10	17
12	7	11	14	9
8	15	12	13	7
11	9	14	8	10
16	18	6	15	4

Three Sum



Cat and Mice

Calculating difference

2 players

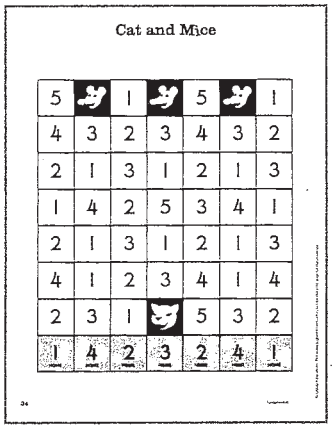
Purpose

In this game, students find the difference between two numbers. Manipulatives are used to help students see that the difference can be calculated by taking away the part that is the same.

Materials

Each pair of players will need

- A 'Cat and Mice' game board (page 34) as shown below.
- Two (2) number cubes made from blank wooden cubes showing numerals 5-10.
- One (1) counter to represent the cat.
- Three (3) counters (a different color to the cat) to represent the mice.
- Forty-five (45) linking cubes. Connect the cubes to make a train to represent each of the numbers 5-10.



How to Play

The aim is for the cat is to 'capture' the three mice as they try to reach the safety of 'home' at the other end of the board.

- One player elects to play the cat.
- The other player controls the three mice.
- The players place their counters on the appropriate pictures on the game board.
- The player for the mice rolls the number cubes and states the difference between the two numbers.
- The player then selects two trains of linking cubes to match the numbers rolled, places them side-by-side, and states the difference again.
- If the player is correct, he or she can move one of the three mice to an adjoining square that shows that difference. The move can be forward, backward, sideways, or diagonally across. If the player is incorrect or the difference is not in a neighboring position, the player misses a turn.
- There are no positions showing '0', so if a player rolls two numbers the same, he or she misses a turn.
- The player for the cat has a turn.
- If the cat moves to a position occupied by a mouse, that mouse is 'captured' and is removed from the board.
- Play ends when all three mice have been removed or when the last mouse reaches 'home'.
- The player for the cat wins if he or she 'captures' all three mice.
- The player for the mice wins if he or she moves the last mouse 'home' safely.

Reading the Research

Research has shown that manipulatives can help students to correct their own errors (Fuson, 1986).

Before the Game

Demonstrate how to use linking cubes to find the difference between two numbers. Select the trains showing 5 and 8. Place them side-by-side and cover up or remove the parts of both trains that are the same. The difference is the amount that is left over.

During the Game

Invite students to explain their thinking strategy before they use the cubes to check their answers. Do they count up from the smaller number or count down from the greater number? Do they use the same strategy for each and every combination of numbers or do they use an alternative method that is better suited to a particular pair of numbers. For example, given 8 and 6, a student may count down from 8 or count up from 6. However, given 10 and 5, the student may simply know the difference is 5 because double 5 is 10.

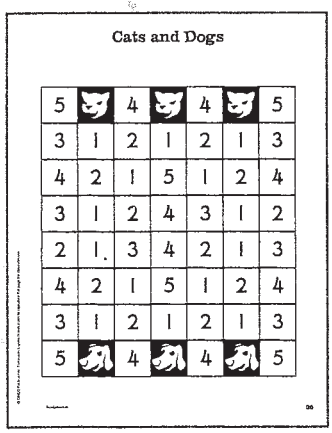
Ask a player to point to a square that he or she would like to move to next. Ask, *What roll would you need to make that score? How do you know?*

After the Game

Have the students work in pairs to figure out all the rolls that would give a difference of one. They could repeat the activity to find all the rolls that would give a difference of 2, 3, 4, 5, and zero. The chart (right) summarizes the results.

	Difference					
	0	1	2	3	4	5
Rolls	10, 10	10, 9	10, 8	10, 7	10, 6	10, 5
	9, 9	9, 8	9, 7	9, 6	9, 5	
	8, 8	8, 7	8, 6	8, 5		
	7, 7	7, 6	7, 5			
	6, 6	6, 5				
	5, 5					

Ask questions such as, *Which difference do you think would appear most often? Why?* (There are six ways of obtaining a difference of zero – more than any other possible difference.) *Do you think it would be easier or more difficult to roll numbers that had a difference of 2 than 4? Why?* (Easier, because there are twice the number of ways to obtain a difference of 2.)



Beyond the Game

- The same game board will work for number cubes that show any counting sequence of six numbers. For example, the students may want to make and use the number cubes that show numerals 10-15.
- Two students may want to play 'Cats and Dogs' using the game board on page 35 (illustrated). They will need the two number cubes used to play 'Cat and Mice'. Each player places his or her three counters as indicated. The object is to capture all their opponent's pieces by moving onto the squares that they occupy. Again, the players move by calculating the difference between the two numbers rolled.

Cat and Mice

5		1		5		1
4	3	2	3	4	3	2
2	1	3	1	2	1	3
1	4	2	5	3	4	1
2	1	3	1	2	1	3
4	1	2	3	4	1	4
2	3	1		5	3	2
1 HOME	4 HOME	2 HOME	3 HOME	2 HOME	4 HOME	1 HOME

Cats and Dogs

5		4		4		5
3	1	2	1	2	1	3
4	2	1	5	1	2	4
3	1	2	4	3	1	2
2	1	3	4	2	1	3
4	2	1	5	1	2	4
3	1	2	1	2	1	3
5		4		4		5