

Notes for the Teacher

Students solve a collection of puzzles in which they add, subtract, and use logical reasoning to find missing numbers in a 3×3 grid. Through multiple plays of random challenges generated by Sketchpad, students work to improve their strategies and scores. The activity concludes with students identifying the strategies they used to solve the puzzles.

Objectives:

- Students will use puzzles to practice addition and subtraction facts.
- Students will compose and decompose two-digit numbers into tens and units.
- Students will develop strategies, using logical thinking and their understanding of place value, to recognize which rows or columns of a cross-number puzzle are suitable for immediate solution and which require other rows or columns to be solved first.

Common Core Mathematical Practices: (1) Make sense of problems and persevere in solving them; (2) Reason abstractly and quantitatively; (3) Construct viable arguments and critique the reasoning of others; (5) Use appropriate tools strategically; (6) Attend to precision; (7) Look for and make use of structure; (8) Look for and express regularity in repeated reasoning.

Common Core State Content Standards: 1.OA1, 3, 4, 6, 7, 8; 1.NBT1, 2, 4, 6; 2.OA1, 2; 2.NBT1, 5, 6, 7, 9; 3.A1; 3.NBT2

Grade Range: Grades K–4

Introduce:

Open **Cross Number Puzzles--Addition and Subtraction.gsp**. Use a projector to show sketch page “Introduction.” Explain that students will solve a series of puzzles in which they work to find missing numbers in a 3×3 grid. Review the rules of the puzzle and work through the example with students:

- The two numbers in the left column are multiples of 10.
- The two numbers in the right column are between 1 and 9.

These numbers are multiples of 10. These numbers are from 1 to 9.

30	5	
20	1	

- The numbers in the rightmost column are the sums of the two rows. ($30 + 5 = 35$ and $20 + 1 = 21$)
- The numbers in the bottom row are the sums of the two columns. ($30 + 20 = 50$ and $5 + 1 = 6$)

30	5	35
20	1	21
50	6	

These numbers are the sums of the rows.

These numbers are the sums of the columns.

- The number in the bottom right corner is the sum of the four numbers that we started with. ($30 + 5 + 20 + 1 = 56$)

30	5	35
20	1	21
50	6	56

This number is equal to the sum $30 + 5 + 20 + 1 = 56$

Now go to sketch page “Game A.” Distribute the worksheet and explain that this puzzle is just like the example.

Ask volunteers to come to the computer to fill in the missing numbers by dragging the red points. Ask students to explain their reasoning for each choice.

50	5	55
10	3	13
60	8	68

Pay attention to how students find the missing number in the bottom-right corner. Some students may realize that they don’t need to add all four numbers ($50 + 5 + 10 + 3$) and can simply add 60 and 8 or 55 and 13 to obtain 68. Don’t mention this shortcut to students; let students come to this realization while solving the puzzles on their own.

Each game in the Sketchpad document consists of 10 random puzzles, and each puzzle is worth 10 points, for a total of 100 possible points.

If students solve a puzzle and press *Next Puzzle*, they'll receive 10 points for a correct answer and 0 points for an incorrect answer. If students press *Check Answer*, Sketchpad will tell them whether their solution is correct and allow them to fix their work if it is not. However, each incorrect check deducts 2 points from the value of the puzzle. So if a student checks her answer and discovers it is incorrect, she will only receive 8 points after fixing her mistake. Nonetheless, when in doubt, checking one's work is a safer alternative than immediately pressing *Next Puzzle*.

If students want to play a game again to improve their score, they should press *Play Another Round*.

Explore:

Assign students to partners and send them in pairs to the computers. Tell students that they will play four different but related games in which they must determine the missing numbers in a grid. Ask students to start on page “Game A” and continue through page “Game D” if they have time. Students can play each game more than once. Game A is the easiest and Game D is the most difficult.

As you circulate, observe students as they work. Notice what strategies students are using to solve the puzzles. Make sure students record their scores and their explanations on the worksheet.

Discuss:

Call students together to discuss and summarize what they learned. Have students share the strategies they used to find the missing numbers in each game. Below are some possible student responses.

- *For Game A, we noticed that to find the number in the bottom-right corner, we could either add the two sums in column 3 or add the two sums in row 3. Adding either pair of sums is the same as adding the original four numbers we were given (10, 8, 10, and 5 in the example below).*

			Add Down
	10	8	18
	10	5	15
Add Across	20	13	33

Game A

- For Game B, we had to use subtraction and addition. In the puzzle below, we started in row 1 by subtracting $35 - 5$. That gave us 30. We then worked on column 1, adding $30 + 30$ to get 60. We then turned our attention to row 3, adding $60 + 10$ to get 70. We then focused on column 3, subtracting $70 - 35$ to get 35. Finally, we completed row 2 by subtracting $35 - 30$ to get 5.

	5	35
30		
	10	

30	5	35
30	5	35
60	10	70

Game B

- Game C was much harder! We subtracted $58 - 20 - 3 = 35$ to find the sum of the remaining numbers in the grid. We broke 35 into a sum with a multiple of 10 and a number from 1 to 9: $35 = 30 + 5$. So, 30 went in the second row in the first

column and 5 went in the first row in the second column. We used addition to find the remaining numbers.

20			20	5	25
	3		30	3	33
		58	50	8	58

Game C

- *For Game C, we started by looking at the bottom-right number and breaking it into tens and ones: $58 = 50 + 8$. We knew the first column sum would be the tens (50) and the second column sum would be the ones (8). After figuring that out, we added and subtracted to find the other numbers.*

20		
	3	
50	8	58

Game C

- *We worked on Game D puzzle for a long time! We guessed numbers until we finally realized that the sum in the second row needed to be broken down into tens and ones. The tens go in column 1 and the ones go in column 2. Once we figured that out, we used addition and subtraction to find the remaining numbers.*

30		
		48
	17	

30	9	39
40	8	48
70	17	87

Game D**Related Activities:**

- *99 Chart—Mental Math Strategies*
- *Jump Along Games—Taking Trips on the Number Line*
- *Paired Sums Game—Mental Math Strategies*
- *Number Navigation—Adding on an Open Number Line*
- *Arranging Addends—Target Sum Puzzles*

Credits:

Cross Number Puzzles appear in the 1960's elementary mathematics curriculum *Math Workshop* by Wirtz, Botel, Beberman, and Sawyer published by Encyclopaedia Britannica Press.

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Portions of this material are based upon work supported by the National Science Foundation under award number DRL-0918733. Any opinions, findings, and conclusions or recommendations expressed in this work are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.