

Notes for the Teacher

Students use a 99 chart (a chart numbered from 0 to 99) to model mental math strategies for addition and subtraction. Four directional controls allow them to navigate through the chart by adding or subtracting 1 or 10. By connecting these movements through the chart with their mathematical meaning, students develop a deeper understanding of addition and subtraction.

Why Use a 99 Chart?

The chart in this activity, starting from the bottom up and numbered from 0 to 99, is particularly useful for representing addition and subtraction dynamically. It differs from the more common hundreds chart in three important ways.

1. The numbers are arranged in the way students talk about them: “higher” numbers are above “lower” numbers, and students move “up” to larger numbers and “down” to smaller numbers.
2. The rows are more coherent. Each row contains numbers related both by words and by their tens-place digit. The first row contains the single-digit numerals, the next row has the “teens,” the next the “twenties,” and so forth.
3. It has a starting place of zero for “counting on.” A student can use “counting on” for both parts of a problem, like $3 + 5$: start at 0, count 3 to the right, and then count 5 more to the right.

Objectives:

- Students will use an interactive 99 chart to model addition and subtraction.
- Students will develop and refine their mental math strategies for addition and subtraction.

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; (4) Model with mathematics; (5) Use appropriate tools strategically; (6) Attend to precision; (7) Look for and make use of structure.

Common Core State Standards: 1.NBT; 2.NBT5, 6, 9

Grade Range: Grades K–3

Introduce:

Use a projector to show the sketch page, “Chart (Version One)” or “Chart (Version Two).” Version One of the chart has *up*, *down*, *left*, and *right* arrows for navigating through it. Version Two replaces the arrows with corresponding mathematical operations (+10, -10, +1, and -1). Pressing the arrows (or +10, -10, +1, or -1) causes the blue square to move appropriately. For the purpose of these notes, we describe Version One of the chart, but you can use Version Two if you wish.

Ask several volunteers to experiment with pressing the *up*, *down*, *left*, and *right* arrows using Sketchpad’s **Arrow** tool. Encourage students to describe what they observe.

Possible responses include:

- *When I press the right arrow, the blue square moves from 0 to 1, leaving behind a trace of its path. The square continues to move to the right each time I press the right arrow.*
- *My blue square is now at 9. I wonder what will happen when I press the right arrow again? Will the square jump to 10? It does!*
- *Each time I press the right arrow, it’s like adding 1 to my current location in the chart.*
- *Pressing the left arrow is like subtracting 1.*
- *Pressing the up arrow is like going up by 10 and pressing the down arrow is like going down by 10.*
- *Pressing the up arrow is like adding 10 and pressing the down arrow is like subtracting 10.*

Return the blue square to 0 by pressing *Reset*. Doing so will also erase all the paths that students have traced in the chart.

Write the following problem on the board: $23 + 16$.

Explain, “We’re going to use this number chart to add 23 and 16. Can someone suggest an idea to try?”

One idea is to start at 0, use the arrows to navigate to 23, and then use the arrows again to add 16 to 23. Students can reach 23 in many ways, but the two most direct paths are shown below.

30	31	32	33	34
20	21	22	23	24
10	11	12	13	14
0	1	2	3	4

30	31	32	33	34
20	21	22	23	24
10	11	12	13	14
0	1	2	3	4

After students navigate to 23, drag the blue point that sits along the multi-color segment. Dragging this point changes the color of the square on the grid and the trace it leaves behind. By changing the color of the square, students will be able to distinguish the portion of their path between 0 and 23 from the portion between 23 and 39 (the trail of the second addend).



Ask students to predict where they will land when they add 16 to 23. Continue by asking how students would like to model adding 16 to 23. Possible responses include the following:

- *We can press the right arrow 16 times to add 16. That would take a long time, though!*
- *We can add 16 by pressing the up arrow once followed by the right arrow six times. This is the same as adding 10 and then 6.*
- *We can add 16 by pressing the right arrow six times followed by the up arrow once. This is the same as adding 6 and then 10.*
- *We can add 16 by pressing the up arrow twice to reach 43. So far, we've added 20. We now need to subtract 4 by pressing the left arrow four times.*

Pick several methods that students suggest and have students model each one. Below is an example of starting at 23 and pressing the *up* arrow once followed by the *right* arrow six times to reach 39.

30	31	32	33	34	35	36	37	38	39
20	21	22	23	24	25	26	27	28	29
10	11	12	13	14	15	16	17	18	19
0	1	2	3	4	5	6	7	8	9

Because it's not possible to erase individual portions of the traced paths, you'll need to return to 0 each time. For each method, ask students to write a corresponding addition statement that describes the movement from 23 to 39. Here are several examples:

- $23 + 10 + 6 = 39$ (Start at 23 and press the up arrow once followed by the right arrow six times.)
- $23 + 6 + 10 = 39$ (Start at 23 and press the right arrow six times followed by the up arrow once.)
- $23 + 20 - 4 = 39$ (Start at 23 and press the up arrow twice followed by the left arrow four times.)

When students are ready to attempt a more challenging problem, try modeling an addition statement like $36 + 47$ on the chart. This problem gives students a good opportunity to use their mental math skills and knowledge of landmark numbers (10, 20, 30, 40, etc.) to devise different ways to add 36 and 47. For each method that students demonstrate in the chart, ask them to write a corresponding addition statement. Here are several possibilities:

- $36 + 4 + 40 + 3 = 83$ (Start at 36 and press the right arrow four times followed by the up arrow four times and finally the right arrow three additional times.)
- $36 + 40 + 7 = 83$ (Start at 36 and press the up arrow four times followed by the right arrow seven times.)
- $36 + 50 - 3 = 83$ (Start at 36 and press the up arrow five times followed by the left arrow three times.)

Explore:

Assign students to partners and send them in pairs to the computers. Give students four to five addition problems to model with the 99 chart. For each problem, ask students to

devise several different methods for modeling the problem. As they did earlier, students should write addition statements that correspond to each of their methods.

As you circulate through the classroom, ask students to describe the strategies they are using to represent each addition problem on the chart. For students who are ready for new challenges, suggest that they use the chart to add three numbers together or use the chart to model a subtraction problem.

Discuss:

Call students together and use a projector to show the 99 Chart sketch. Pick several problems that students solved and ask them to demonstrate their use of the chart and the addition statements they wrote.

To continue, write problems like the following on the board:

$$23 \uparrow \uparrow \rightarrow \rightarrow$$

$$15 \downarrow \leftarrow \uparrow \rightarrow \rightarrow \rightarrow \uparrow$$

Explain that each problem starts with a number and describes movements through the chart, indicated by the arrows. Ask students to determine, without using the Sketchpad chart, where they will land after performing the various movements indicated by the arrows. For example, $23 \uparrow \uparrow \rightarrow \rightarrow$ corresponds to the following addition statement:

$$23 + 10 + 10 + 1 + 1 = 45$$

And $15 \downarrow \leftarrow \uparrow \rightarrow \rightarrow \rightarrow \uparrow$ corresponds to:

$$15 - 10 - 1 + 10 + 1 + 1 + 1 + 10 = 27$$

Students will likely enjoy creating such problems for each other.

Related Activities:

- *Number Navigation—Adding on an Open Number Line*

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