

# Go Figure!



**Number Sense Routines That  
Build Mathematical Understanding**



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**VIEWING GUIDE**

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# INTRODUCTION

## NUMBER SENSE ROUTINES

*Go Figure!* brings number sense routines to life, providing a window into how you can go about setting up these daily opportunities for students to develop and deepen their mathematical understanding. The video was filmed in October in three public school classrooms in Logan, Utah. Because the school year had just recently begun, the teachers were still setting up expectations for each routine, getting to know their students' number sense, and developing norms for classroom discussions about mathematics.

Catherine Ermer, first-grade teacher at Adams Elementary, demonstrates her varied use of visual routines. Camilla Webb and her second-grade students at Bridger Elementary play with numbers as they discuss Ways to Make 100. Jalyn Kelley's fourth-grade students at Wilson Elementary talk about multiplicative patterns as they count by fours on number line mats. You will also see Jessica Shumway, author of *Number Sense Routines* (Stenhouse, 2011), facilitate Quick Images, Count Around the Circle, and Count Around the Room in each of the three classrooms.

The various routines highlight important number sense ideas such as composing/decomposing numbers, estimation, magnitude of numbers, number relationships, and number system concepts. Seeing various number sense routines in action provides the “what” and “how” of these routines—teachers and coaches can step into classrooms where number sense routines are beginning to be implemented. The reflective interviews with Catherine, Camilla, Jalyn, and Jessica explain the “why”—why this routine, why those numbers, and why those specific teacher moves.

Number sense is foundational for all mathematics learning. Because number sense takes time and multiple experiences to develop, these routines provide an important daily structure for students to build deep, interconnected knowledge of numbers.

This viewing guide is organized around the types of routines explored in Jessica's *Number Sense Routines*: Visual Routines, Playing with Quantities, and Counting Routines. Each section begins by providing a brief overview of the routine and its purpose. In “Number Choices” you will gain further insight into teachers' planning and the reasoning behind their number choices for the routines. “Teacher Moves” and “Reflection and Next Steps” highlight actions and ideas to notice and discuss as you watch the video segments.

# VISUAL ROUTINES

## SEEING AND CONCEPTUALIZING QUANTITIES

### What Are Visual Routines?

Visual routines support students' visual understanding of quantities. Using various representations of quantities—whether dot cards, ten-frames, or the abacus—helps students better understand how numbers are composed and decomposed and see the relationships of numbers to one another.

### Number Choices

Visual routines can be used to develop kindergarten students' subitizing abilities. They can be used to help second graders visualize their math facts. They can even be used to visualize multiplicative ideas with third graders. The possibilities are endless! The numbers you choose, as well as the tool (dot cards, ten-frames, and/or the abacus) and the arrangements of those quantities, are the essential elements in highlighting important mathematical concepts—everything from combinations of ten to the commutative property of addition. Jessica and Catherine think carefully about the quantities and representations they choose for the day's number sense routine, and their discussion lets us take a look into the planning and reasoning behind their number choices.

### Quick Images in a Guided Math Group (First Grade), 16:00–24:48

In this video segment, Jessica meets with a small group of students during Guided Math. They have been solving story problems and building a repertoire of strategies for tackling various problem types. This lesson uses the following story problem:

Elliot was outside observing the fall weather. He started collecting pinecones. Elliot found 4 large pinecones, 4 small pinecones, and 2 broken pinecones. How many pinecones did Elliot find?

Jessica predicts that some students will use their knowledge of  $4 + 4 = 8$  and then count up two more to get to 10 pinecones (i.e., using a doubles fact, then counting up). She also expects that others might combine 4 and 2 to make 6 and then use  $6 + 4 = 10$  (i.e., a friendly ten combination). To warm up their brains for the story problem, Jessica decides to use a Quick Images routine that provides the small group of students an opportunity to play with the quantity of four. She chooses two different ten-frames of four to begin the routine: four dots presented in a square, then four dots presented in a horizontal line. She hopes the first graders will think about the number four flexibly as well as think about four's relationship to ten. Jessica decides to use a double ten-frame (with a full frame of ten dots and a frame with four dots) to assess how students are thinking about four within the context of a teen number.

## Visualizing Quantities (First Grade), 35:59–45:54

Catherine uses the ten-frame as a part of students' daily routine of counting the days of school. She chooses the current day of the school year as the “number of the day” in order to give students an opportunity to explore a growing amount. Each day, the first graders discuss how the number is composed (how many tens and ones) and how the number is related to 100. In the video segment, Catherine's students discuss the number 41.

After students discuss the number 41 within the context of the ten-frame, they concretely play with the number 41 using the abacus. Catherine helps students connect the concrete representation with symbolic notations of 41. In the last part of this daily routine, the students record various representations of 41 in their Target Number books.

## Teacher Moves

Some teacher moves to notice and discuss in these clips:

### Quick Images

- Setting up opportunities to learn from each other
- Providing opportunities to talk about how numbers are composed and decomposed
- Linking the visual images from the routine to the computation involved in the story problem

### Visualizing Quantities

- Using multiple representations of the same number
- Providing opportunities to play with 41 in various formats

## Reflection and Next Steps

### Quick Images

- How did students describe the dot arrangements?
- What important mathematical ideas emerged during Quick Images?
- How did one student use her visualization of quantities to solve the story problem?
- Which Quick Images, quantities, and dot arrangements would you choose for the next meeting of this Guided Math group in order to plan a responsive routine? Which numbers would you choose for their next story problem?

### Visualizing Quantities

- How do you think multiple representations of one number enhance students' number sense?
- In what ways does Catherine connect and link these multiple representations?
- What kinds of mathematical understandings do you think these students are building over time?

# PLAYING WITH QUANTITIES

## MAKING SENSE OF NUMBERS AND RELATIONSHIPS

### What Are Playing with Quantities Routines?

Playing with quantities routines encourage students to explore how numbers are composed and decomposed and how numbers are related to one another. These routines also provide a platform for students to represent numbers in various ways—concretely, visually, and symbolically—as well as to link these representations of numbers. Place-value concepts, properties of numbers, and properties of operations are often the key mathematical ideas highlighted during these routines. Overall, playing with quantities routines help students think about numbers in flexible ways.

### Number Choices

Playing with quantities routines, such as Ways to Make a Number, can be used as a platform for composing and decomposing amounts, representing amounts, discussing number combinations, talking about properties of numbers, and a myriad of other key number sense concepts.

Teachers might choose a number in order to assess students' current conceptions of that amount. For example, when students write Ways to Make 14, are they thinking about this teen number as a ten and four ones? When students are playing with a larger number such as 1,000, where are their place-value understandings fragile? To what point are their place-value understandings pretty solid?

Teachers can also use Ways to Make a Number to encourage discussions about computation strategies. For example, when students write Ways to Make 50, a teacher can focus the whole-class discussion on subtraction equations that students write down:  $100 - 50$ ;  $60 - 10$ ;  $75 - 25$ . In this scenario, the teacher might have chosen 50 because it is an accessible number to students. She can predict some equations students might come up with that could then focus a discussion about leaps of ten in subtraction. Again, the possibilities are endless, and different numbers will lead to various mathematical key ideas and discussions. Camilla's number choice for the day's lesson was based on her students' work from several days of Ways to Make a Number.

### Ways to Make a Number (Second Grade), 24:49–35:50

The Ways to Make a Number video segment showcases just one of the many playing with quantities routines. In this segment, Camilla chooses Ways to Make 100 as the focus for the day's number sense routine. Her second graders had been focusing on combinations of ten during their mathematics lessons. Earlier in the week, Camilla used Ways to Make 10 to assess how students were progressing in their thinking about combinations of 10 as well as their flexibility in thinking about the number 10. She chooses 100 for the day's routine to see how students generalize their understanding of 10 to the larger number 100 and is

looking for a discussion about place value (ones, tens, and hundreds), groupings of amounts, and children’s use of combinations of 10 to come up with combinations of 100.

## Teacher Moves

Some teacher moves to notice and discuss in this clip:

### Ways to Make a Number

- Using individual think time combined with partner talk, followed by whole-class discussion
- Setting up opportunities to learn from each other
- Providing opportunities to reflect on and synthesize learning by turning and talking to a partner at the end of Ways to Make 100

## Reflection and Next Steps

### Ways to Make a Number

- What did you notice about students’ conceptions of 100?
- Camilla described why she chose 100 for the day’s routine. How does her number choice show her responsiveness to students’ current understandings? In other words, how did Camilla use this as a “responsive routine”?
- How did Camilla use Ways to Make a Number as a formative assessment tool?
- What kinds of important mathematical ideas came out during the whole-class discussion of Ways to Make 100?
- Camilla explained that the purpose of the Ways to Make a Number whole-class discussions during October had been to get lots of ideas on the board (i.e., a “splatter” of ideas) in order to show students that there are many ways to think about a number. How could she plan upcoming discussions to focus on key mathematics ideas? What kinds of number combinations do you think she should highlight during her second graders’ upcoming discussions?

# COUNTING ROUTINES

## UNDERSTANDING PLACE VALUE AND THE NUMBER SYSTEM

### What Are Counting Routines?

Counting routines help students become better acquainted with the number system and gain a stronger sense of how numbers work. As students build counting proficiency, they refine their sense of patterns in the number system, understand how numbers are organized and relate to one another, practice estimation, and develop deeper understandings of place value.

### Number Choices

Teachers can start counting routines with simple counting sequences, such as “Count by ones starting at 52” or “Count by tens starting at 0,” in order to get students talking about patterns in counting. Once the routine has been established and students become more skilled with the counting and the discussions about patterns, teachers can begin to facilitate more difficult counting sequences that highlight patterns in the place-value system, require more rigorous computation strategies to figure out “what comes next,” and generalize number sense concepts to larger and larger numbers. In the counting routines video segments, Jessica and Jalyn choose the day’s counting sequences for very specific instructional reasons.

#### Count Around the Circle (Second Grade), 02:58–16:01

In this segment, second graders are counting backward by ones, starting at 60. Subtraction is typically difficult for second-grade students; however, this group has started to show interest in experimenting with subtraction concepts. Counting by ones makes counting backward more accessible. In addition, Jessica sets up three number lines on chart paper before counting around the circle and purposely writes only the tens (e.g., 60, 50, etc.) as a way to scaffold counting backward.

#### Counting on the Number Line (Fourth Grade), 45:55–1:03:00

Jalyn used counting by fours starting at zero as the sequence for the day’s Counting on the Number Line routine. She wanted a fairly simple counting sequence so her fourth graders could notice the patterns of multiples. By using this familiar counting sequence and pattern, Jalyn wanted to spend less time counting and more time focusing the discussion on estimates, multiples of four, and multiplication patterns. She hoped students would use their knowledge of fours to talk about multiplying two-digit by one-digit numbers. She began the Counting on the Number Line routine by asking students to count by fours and write the sequence on the first number line only. She asked students to estimate what they might land on at the end of the number line mat and to write that estimate on their mats. She then asked them to continue writing the counting pattern on the next two lines.

This video segment begins when Jalyn turns to a whole-class discussion about students' estimates. She carefully planned the timing of this question so that students would have enough of a pattern to make a reasonable estimate. By writing the numbers on their number line mats, she hoped students would begin to notice patterns and multiplicative ideas.

### Count Around the Room (Fourth Grade), 1:03:01–1:19:28

The fourth-grade students in this segment have been counting easily by tens from various starting points, such as counting by tens starting at 354. Since the children are able to count quickly and fluently, Jessica can focus on facilitating discussions about place value and estimation. Jessica and Jalyn tried counting by twelves earlier in the week, which slowed down the fluency of Count Around the Room. This more challenging count, however, encouraged students to discuss strategies for adding by twelves or using patterns to figure out “what comes next.” For this day’s Count Around the Room routine, Jessica chooses counting by fifteens to build on the discussions students had about counting by twelves. She knows it will take longer to count around the room and plans to hold an open discussion about the new strategies and patterns the children use to count by fifteens. She hopes discussions of multiplication might come up in the conversations but is not sure if these ideas will emerge.

## Teacher Moves

Some teacher moves to notice and discuss in these clips:

### Count Around the Circle

- Using wait time
- Using number lines to support students’ counting sequence and discussions about the counting sequence
- Using partner talk
- Providing an opportunity to play with negative numbers without detracting from the day’s routine

### Counting on the Number Line

- Using an easy counting sequence to focus on a discussion about patterns and multiplication
- Using individual number line mats
- Using partner talk
- Keeping discussion focused on one key idea
- Using questions to probe and extend students’ thinking (e.g., “Does that always work?”)
- Discussing metacognitive and comprehension strategies with students
- Using a math journal for reflection

### Count Around the Room

- Using a challenging sequence to practice mental computation (adding by fifteens)
- Recording numbers vertically in groups of six (each column has six numbers)
- Using partner talk

- Encouraging children’s focus and participation
- Asking specific students to share because of a key idea that is important to discuss with the whole class

## Reflection and Next Steps

### Count Around the Circle

- Which mathematics ideas emerged in students’ discussions?
- Which counting sequences would you use next with these second-grade students?
- What other kinds of visual scaffolds could Jessica use to support students’ counting as well as their discussions about patterns and place value?

### Counting on the Number Line

- With the same group of fourth-grade students, Jessica chose a challenging number to count by (fifteens) and Jalyn chose an easier counting sequence (fours). When do you think it is important to use challenging sequences and easier sequences? What is the purpose of each?
- How did Jalyn provide opportunities for students to think deeply about mathematics?
- Why were the math journals and time to reflect so important to this routine?
- What number sequence would you use next with this class?

### Count Around the Room

- Which mathematics ideas emerged in students’ discussions?
- What were students’ strategies for figuring out what comes next in the counting sequence?
- Which numbers were “tricky leaps”? Why were those leaps tricky?
- What number sequence would you use next with this class?

# TIME CODES

<b>Introduction:</b> Number Sense Routines	00:00–02:57
<b>Count Around the Circle</b> (Second Grade)	02:58–16:01
<b>Quick Images in a Guided Math Group</b> (First Grade)	16:02–24:48
<b>Ways to Make a Number</b> (Second Grade)	24:49–35:50
<b>Visualizing Quantities</b> (First Grade)	35:59–45:54
Counting the Days in School	35:59–39:11
Visualizing Amounts with the Abacus	39:12–41:45
Target Number	41:46–45:54
<b>Counting on the Number Line</b> (Fourth Grade)	45:55–1:03:00
<b>Count Around the Room</b> (Fourth Grade)	1:03:01–1:19:28
<b>Conclusion:</b> Students' Number Sense Journeys	1:19:29–1:21:33
<b>Special Section:</b> Frequently Asked Questions	0:00–17:52