Research Lesson Proposal for 2nd Grade: Numbers Greater Than 1000

For the lesson at the Chicago Lesson Study Conference on May 18, 2018

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At Prieto Lesson Study Conference

Title of the Lesson: Let's Investigate Numbers Greater than 1000

1. Brief description of the lesson:

Students will receive a picture with 2,354 pennies. Students will grapple with how to count, name and write a number that is greater than a thousand. Students will recall that when they previously counted large numbers of objects in previous lessons, they made groups of tens and hundreds. Students will build off their knowledge from a previous lesson to see the efficiency in counting in groups, and even counting with groups of a thousand.

Unit goals

- Students will deepen their understanding of numbers as they expand their knowledge of the base-10 structure of numbers up to ten thousand.
    - Students will recognize the benefit of making groups of tens and hundreds to count, connect grouping of tens and hundreds with the base-10 numeration system, and use base-10 positional regularity in the process of calculating
    - Students reason about and express the base-10 numeration system, demonstrating an understanding of the relative size of numbers
    - Students read and write 4-digit numbers and express the relative size of numbers using symbols for equality and inequality
    - Students will understand the structure of numbers, know how to read and write 4-digit numbers, and compare the relative size and order of numbers.

2. Research Theme

Construct viable arguments and critique the reasoning of others.

Students to be able to use mathematical language and models to describe and justify their thinking, as well as respond to, add on to, and critique the strategies of their peers.

3. Lesson goals

- Students know how to name, count, and write numbers less than ten thousand in the base-10 value number system
    - Students learn the structure of a 4-digit number and how to read these numbers (2354)
    - Students recognize that ten groups of 100 make "one thousand" and two groups of

1000 make “two thousand.”
- Students understand that putting “two thousand” and “three hundred fifty-four” together makes the number “two thousand three hundred fifty-four.”
- Students understand how to read the number that has 2 groups of a thousand, three hundreds, five tens, and 4 ones as “two thousand, three hundred fifty four.”

4. Relationship of the Unit to the Standards:

Standard: Understand place value.

CCSS.MATH.CONTENT.2.NBT.A.1

Understand that the three digits of a three-digit number represent amounts of hundreds, tens, and ones; e.g., 706 equals 7 hundreds, 0 tens, and 6 ones. Understand the following as special cases:

CCSS.MATH.CONTENT.2.NBT.A.1.A

100 can be thought of as a bundle of ten tens — called a "hundred."

CCSS.MATH.CONTENT.2.NBT.A.1.B

The numbers 100, 200, 300, 400, 500, 600, 700, 800, 900 refer to one, two, three, four, five, six, seven, eight, or nine hundreds (and 0 tens and 0 ones).

CCSS.MATH.CONTENT.2.NBT.A.2

Count within 1000; skip-count by 5s, 10s, and 100s.

CCSS.MATH.CONTENT.2.NBT.A.3

Read and write numbers to 1000 using base-ten numerals, number names, and expanded form.

CCSS.MATH.CONTENT.2.NBT.A.4

Compare two three-digit numbers based on meanings of the hundreds, tens, and ones digits, using >, =, and < symbols to record the results of comparisons.

Relationship of unit to standards:

In this unit, students expand on this knowledge to understand the structure of a four-digit number. Students will deepen their understanding of the structure of numbers and recognize that the four digits of a four-digit number represent amounts of thousands, hundreds, tens, and ones (2.NBT.A.3). With a deepened understanding of the structure of numbers, students will read and write numbers greater than 1000 using base-ten numerals, number names, and expanded form. They will recognize that ten 10s is 100, and a bundle of 10 hundreds is called one thousand (2.NBT.A.1.A). In this unit, students will also use their understanding of the structure of four-digit numbers to compare the relative size and order of numbers (2.NBT.A.4).

5. Background and Rationale

Rationale for choosing our research theme:

Research Theme: ***Construct viable arguments and critique the reasoning of others.***

Students to be able to use mathematical language to describe and justify their thinking, as well as respond to, add on to, and critique the strategies of their peers.

The research theme for the unit and lesson comes from Common Core State Standard for Mathematical Practice 3: construct viable arguments and critique the reasoning of others. Our school-wide research theme was chosen because, as a school, we want to focus on students developing the skills to defend their math conclusions, discuss their math with peers, and question or critique their peers' math or even their own math. With our transition to learning through problem-solving and the Sansu math curriculum, we saw that there was a great need for students to improve their ability to explain their reasoning using mathematical language or models. Through math journals and problem-solving lessons, we expect that students will improve in providing justification for their own thinking, and be able to question, critique, and respond to their peers' math. We wanted to further expand and develop our ability to facilitate mathematical discussion among our students. This will ultimately achieve our goals of helping students verbalize their ideas, develop mathematical vocabulary, and foster a trusting learning community.

Each of the lessons described in the unit includes student discussion of mathematical strategies, with an emphasis on questioning and feedback given by students to their classmates.

In this unit, students will be given the opportunity to use mathematical language, models, and their knowledge of the structures of numbers to discover numbers greater than 1000. As they seek to understand the structure of four-digit numbers, they will use models, understanding of place value, and mathematical language to describe their thinking and critique the mathematical reasoning of their peers.

Rationale for teaching our unit topic:

This unit topic is not technically a second grade common core standard; it is, instead, a third grade standard. Still, we chose to teach it toward the end of the year. We chose this topic for a few reasons. We have noticed that our students have a solid understanding of place value. As we have used the Sansu Japanese math curriculum, students have developed a strong sense of the base-ten system. They were so excited when we learned about numbers greater than 100, and since then, I have had students asking when we will learn about numbers greater than 1,000. I have noticed students struggling with how to say numbers when we read, and I have also noticed students struggling to conceptualize a quantity if it is over 1000. As a second grade team, we have also observed that some students get stuck or confused when counting from one place value into another. For example, 1 more than 999 or 1 less than 1,000. We have also noticed that when students estimate a larger quantity, they tend to make illogical estimates. For example, there may be 900 of something, but some students will say the largest number they can think of. I

think this unit will improve our students' understanding about the relative size of numbers. I know students will be eager to extend their understanding of place value. Furthermore, this lesson will be very interesting for the second grade team. We have never taught this lesson before, and it will really allow us to evaluate our students' understanding of the base 10 system and how to manipulate numbers according to rules of that system.

Most of the students at Chavez are ELLs, and this unit will really give students the opportunities to use academic vocabulary to discuss numbers greater than 1000. It is also one of the last times students see a new place value concretely, and our ELL students (and all of our students) will gain a lot from the visual representation of numbers greater than 1000. The unit gives students a chance to manipulate place value cards to deepen their understanding of different ways to express and make numbers. Another factor in choosing this unit was that our students will be able to express numbers greater than 1000 in words and numerically. Seeing the connection between these two ways of expressing a number will be very beneficial for our second graders.

6. Research and *Kyozaikenkyu*

We researched the development of the place value concept across primary grades and found some really interesting things about how students from kindergarten begin to develop their understanding of place value, and how that understanding is built upon in the subsequent grades, eventually becoming more formalized with students seeing the regularity of the base-ten structure.

We investigated the Sansu math curriculum, materials based on a popular primary and elementary math curriculum widely used in Japan, and the Common Core Progressions on Counting and Cardinality about the foundation for understanding counting on and relative number size.

<u>Kindergarten</u>

Common Core Progression:

1. Students become fluent in saying the count sequence so that they have enough attention to focus on the pairings involved in counting objects. To count a group of objects, they pair each word said with one object. Later, students can count out a given number.
2. Students understand that the last number name said in counting tells the number of objects counted.
3. Finally, understanding that each successive number name refers to a quantity that is one larger is the conceptual start for Grade 1 counting on. Prior to reaching this understanding, a student might have to recount entirely a collection of known cardinality to which a single object has been added.

Sansu Math Curriculum: Students recognize a group of 10 and some more. Students do not yet recognize a group of ten as its own place value.

<u>First Grade</u>

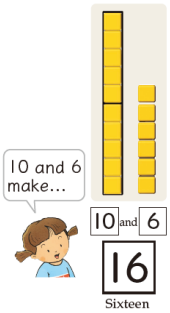
Common Core Progression:

Grade 1 students use their base-ten work to help them recognize that the digit in the tens place is more important for determining the size of a two-digit number

Sansu Math Curriculum:

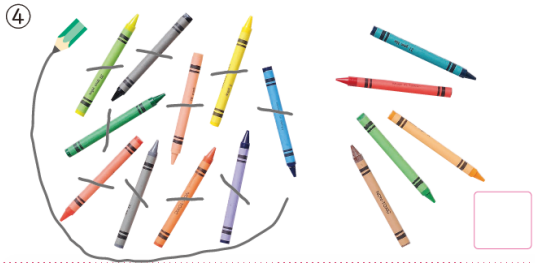
The 1st grade Sansu curriculum immerses students in counting, recognizing and making numbers up to and including 100. Students represent numbers using concrete counting blocks, semi-concrete counting blocks and a ten-block tray. They develop a foundation for understanding the base-10 system by structuring numbers as "10 and 3 make 13" and "10 and 6 make 16". This allows students to see numbers as having separate place values with their own value. For example, teachers emphasize that in the number 26, the "2" represents 2 tens and the "6" represents 6 ones. Later on, they can generalize this structure to numbers greater than 20. For example, if they understand that 10 and 4 make 14, they can use that prior knowledge to understand that 80 and 6 make 86.

1st Grade Sansu Math Curriculum, Unit 6
"Numbers Greater Than 10"

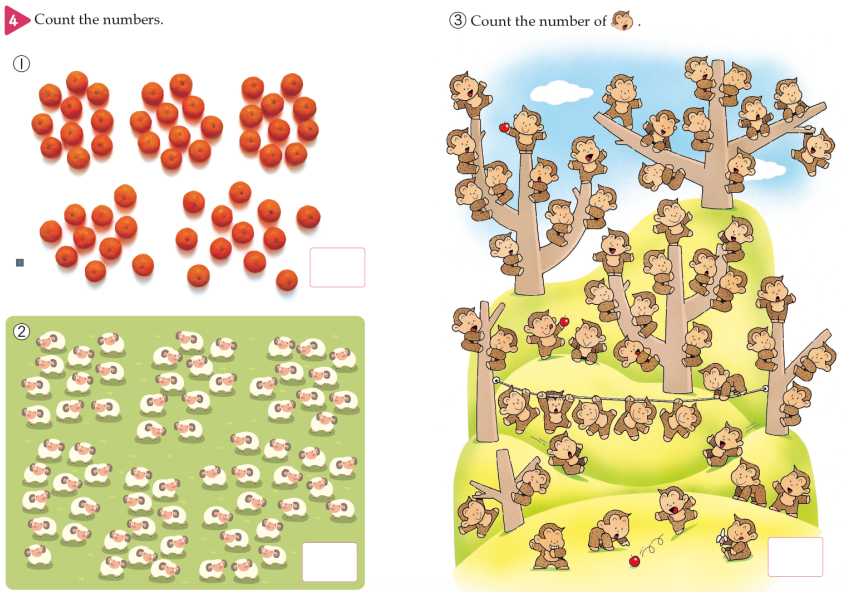


The goal in 1st grade in terms of base-10 numbers is to move students forward with a solid foundation for understanding the structure of base-10 numbers. A large part of that foundation is understanding the usefulness of making groups of 10 when they count larger quantities. The 1st grade Teacher's Guide adds that, "grouping by tens is critical because it is a generalized approach that will be used to extend the range of numbers in the future."

1st Grade Sansu Math Curriculum, Unit 6
"Numbers Greater Than 10"



1st Grade Sansu Math Curriculum, Unit 16
"Numbers Greater Than 20"



Second Grade:

Common Core Progression:

In Grade 2, students extend their understanding of the base-ten system by viewing 10 tens as forming a new unit called a "hundred."

Unlike the decade words, the hundred words indicate base-ten units. For example, it takes interpretation to understand that "fifty" means five tens, but "five hundred" means almost what it says ("five hundred" rather than "five hundreds"). Even so, this doesn't mean that students automatically understand 500 as 5 hundreds; they may still only think of it as the number reached after 500 counts of 1

Comparing magnitudes of two-digit numbers draws on the understanding that 1 ten is greater than any amount of ones represented by a one-digit number. Comparing magnitudes of three-digit numbers draws on the understanding that 1 hundred (the smallest three-digit number) is greater than any amount of tens and ones represented by a two-digit number. For this reason, three-digit numbers are compared by first inspecting the hundreds

In Grade 2, students will further their understanding of larger numbers by arriving at the conclusion that 10 hundreds are a new unit called "thousand"

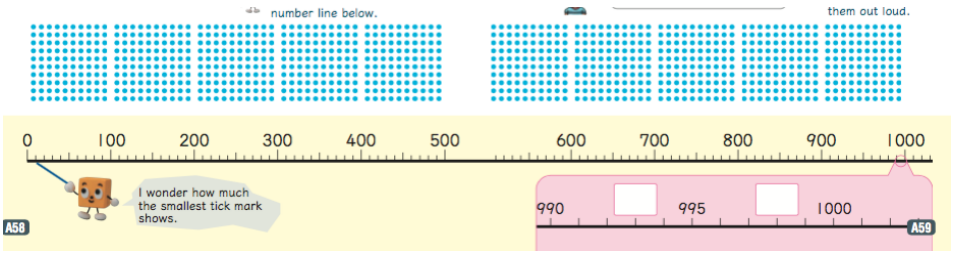
After the introduction of the new word "thousand", in 2nd grade, number words after one thousand will mean what they say, meaning that 1,100 can be read "1 thousand 1 hundred" or "eleven hundred"

Sansu Math Curriculum:

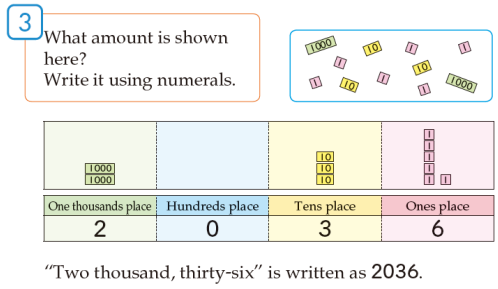
Although CCSS specifies that 2nd graders only name, read and write numbers up to 1000, the Sansu curriculum justifies students learning numbers up to 10,000 as it shows students the continuity of the base-10 structure. According to the 2nd grade Teacher's Guide, "students [will] make connections by seeing the regularity of the base-10 structure of 4- and 5-digit numbers to that of 3-digit numbers learned previously." They add that students will see the that 10 groups of the previous place value will make a unit that is one place value greater.

The goal in 2nd grade is also to have students continue developing a good number sense and seeing numbers in multiple different ways. Students will be able to read the number 3240, represent it as 3000 + 200 + 40, and describe it is 3 thousands, 2 hundreds, and 4 tens. They draw on that knowledge to figure out which representation is best to learn new concepts and also understand the relative size of numbers.

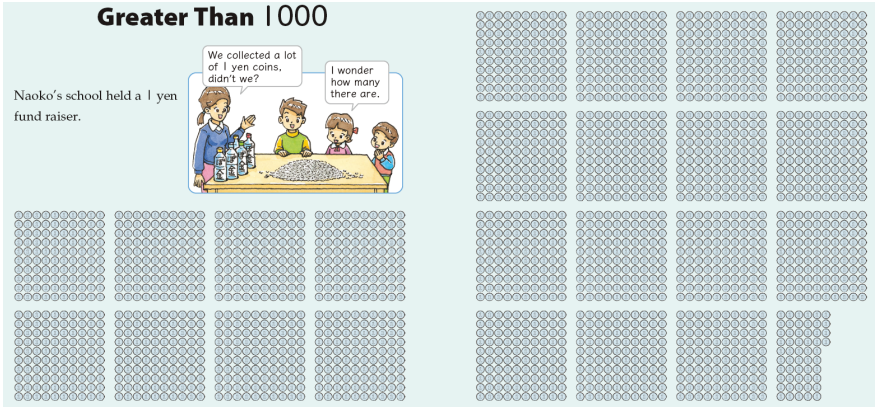
2nd Grade Sansu Math Curriculum
Unit 6: "Let's Investigate Numbers Greater than 100"



Unit 14
"Let's Investigate Numbers Greater Than 1000"



2nd grade is the last time students will see a visual representation of a new place value (see picture below).

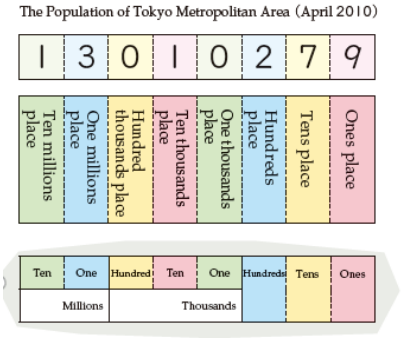


Therefore, it is important for students to have a good command of the concept of the base-10 system as they work theoretically with place value.

3rd graders using the Sansu curriculum will be expected to read, write, and reason with

numbers up to and including the ten millions place. This is not a 3rd grade common core standard; the standard is actually read, write, and reason with numbers up to 10,000. In 1st grade and 2nd grade, the curriculum slowly introduces the place values of tens, hundreds, and thousands to give them the foundation to fluently reason with 5 additional place values. Students can generalize their understanding that "10 groups of a place value creates another larger unit" for the place values of hundred thousands, one million, and ten million. Students should also be able to recognize that the "1" in the number 3010279 represents not "1" of something, but 1 ten thousands of something.

3rd Grade Sansu Math Curriculum, Unit 8
"Let's Investigate Numbers Greater Than 10000"



7. Unit Plan: Taken mostly from Sansu Math Unit 11 "Let's Investigate Numbers Greater than 1000"

Lesson	Learning goal and tasks
a	• Count numbers less than 1000 and see the value in making groups of 10 and 100
b	• Count and read the number 1000
c	• Compose and Decompose 3-digit numbers
1	• Count and read numbers less than ten thousand in the base-10 place value system
2	• Students name, count, and write numbers less than ten thousand in the base-10 place value system of numbers. • Understand the base-10 structure of 4-digit numbers.
3	• Write 4-digit numbers with a vacant (zero) place. • Read and write 4-digit numbers.
4	• Students understand the structure of numbers less than ten thousand by representing numbers using a place value chart and number cards.
5	• Compose and decompose 4-digit numbers based on the structure of numbers. • Represent the structure of base-10 numbers using equations. • Compare 4-digit numbers and represent the relationships with inequality signs.
6	• Students compare the relative size of numbers up to 10,000

7	• Represent 4-digit numbers on the number line. • Understand size relationships and the sequence of 4-digit numbers.
8	• Understand the structure of the number ten thousand (10,000); read and write the number "10,000." • Understand the numbers just before and just after ten thousand
9	• Read and represent whole numbers less than and equal to ten thousand on the number line.
10	• Represent the numbers up to and equal to ten thousand in various ways.
11	• Deepen understanding of the unit's content. (Mastery Problems)

8. About the Unit and Lesson

The unit is designed to give students numerous opportunities to problem solve on their own and in collaboration with other students, and further their understanding of the base-ten system. From the first lesson where students are able to visualize this new place value, to the 6th lesson when students compare 4-digit numbers, students are developing a deeper number sense. Students will work independently but they will also spend time sharing their thinking and defending their mathematical arguments during a daily whole group math discussion. Students will take part in critiquing their own work and the work of their peers. Through these problem-solving experiences we hope that students will gain academic success and also develop the skills to discuss and defend mathematical arguments. Students at Chavez are majority English Language Learners and therefore the opportunity to not only do math but talk about math is extremely important to their ability to problem-solve.

The Design of the Lesson

1. Presentation of ideas
    a. Our presentation of ideas starts with giving our students a familiar context. Our school has a fundraiser called Pennies for Patients. This context provides a reason for students to count the pennies.
    b. We were worried that some of our students would want to count the dollar amount of the pennies, as this is what many of them have done with money (and specifically pennies) in a past Sansu lesson. Because of this, we thought stating the number of pennies the second grade classes collected would steer students away from counting the dollar amount and toward counting the number of pennies.
    c. For the estimation, we will show our students an enlarged color copy of the pennies. We don't want them to be able to start counting themselves in this part, so we decided to have them all look at the picture together.
2. Posing the Task
    a. The task is in the Sansu textbook. My students are very familiar with this text, and we use it weekly. The issue is that the pennies are split between two pages.

Students would be distracted by the book closing or trying to push down the pages. Furthermore, it automatically split the pennies into two separate groups that are not meaningful. For these reasons, each student will get a paper copy of the pennies. In order for students to group the pennies, they will also be provided with different colored pencils or highlighters to use.

3. Comparing and Discussing
    a. Students will turn and talk to their math partner to find out how their partner counted. Students will explain to each other how they counted the pennies. This will give us insight into students' thinking, and will also allow the teacher to circulate the room to hear students' strategies.
    b. During our discussion, students who come up to share their ideas will explain how they counted the pennies. The Sansu teacher guide suggests simply writing in words how students counted. Because so many of our students are ELLs, we decided each student idea would be accompanied by the picture of the pennies. Students will explain how they counted, and the teacher will circle the pennies according to what the student says.
4. Summing up
    a. Students will turn and talk to their partner about what they learned today. This is a good way for the teacher to begin to evaluate what students took away from the lesson.
    b. The class will develop a summary statement for our learning.
    c. Reflection: Students will reflect on what they individually learned or noticed from the lesson. This gives them time to reflect on their own learning, and gives the teacher a way to understand where students are relative to the lesson goal. Students are provided sentence stems for their reflection.

9. Lesson Plan

Steps, Learning Activities Teacher's Questions and Expected Student Reactions	Teacher Support	Points of Evaluation
1. Presentation of Ideas Students study the picture of many pennies and discuss the situation. Remind students about the Pennies for Patients fundraiser we had in the winter at Chavez. Ms. Corona is counting the pennies. Ms. Soto's class collected 649 pennies. Ms. Jorgensen's class collected 806 pennies. Our class collected 917 pennies. Now Ms. Corona is counting Ms. Cabrera's pennies.	Help students recall that when they counted large numbers of objects in previous lessons, they made groups of tens and hundreds.	Are there estimations reasonable? Do students recognize how the pennies are grouped? Are students eager to figure out how many pennies there are?

<table>
<tr>
<td>She is tired of counting, so I told her we were excellent counters. She needs our help!

Look at the pennies. How many pennies do you think there are? Why do you think so?
-Students estimate the number of pennies by looking at the picture.

Anticipated Responses for Estimation:
- One group of pennies has 100 pennies, so there are more than 100 pennies.
-There are many groups of 100 pennies, so there are 1000 pennies.
-One group of pennies has 100 pennies, and there are more than 10 groups, so there are more than 1000 pennies.</td>
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<tr>
<td>2. Posing the Task

Problem: How many pennies are there? Think about the way you’re counting the pennies.</td>
<td></td>
<td>Are students thinking about the quantity of pennies (as opposed to amount of money)?</td>
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<td>3. Anticipated Student Responses

R1: Circle 100 pennies as a group and use the grouping strategy to count the total.

- 23 groups of 100 and then 5 tens and 4 ones.
- 23 hundred 54
R2: When counting up to 1000, use a different color (or different circle) to show groups of a thousand.

- 2 thousands, 3 hundreds, 5 tens, 4 ones
- Get stuck after 1 thousand
- 1000+1000+300+50+4
- 2354 (twenty-three fifty-four)
- twenty-three hundred fifty-four
<table><tr><td>Hundreds</td><td>Tens</td><td>Ones</td></tr><tr><td>23</td><td>5</td><td>4</td></tr></table>
Students will turn and and talk to a partner about their answer.</td>
<td>If students count 1 by 1:

Help students recall that when they counted large numbers of objects in previous lessons, they made groups of tens and hundreds.

Help students recall how they counted large numbers of objects in past lessons and help them recognize it is not easy to count large quantities one object at a time, so it is a good idea to make and count groups of objects.

Can you explain how you counted the pennies?

Can you show me how you grouped the pennies?</td>
<td>Are students counting efficiently with groups?

What do students do when they get to 10 hundreds?

How are students recording or writing down the amount of pennies?</td>
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<td>4. Comparing and Discussing

a. I circled a group of 100 pennies and saw that there were 23 groups of 100 and then 54 more pennies, but I don’t know how to say the number of coins.

b1 Place Value Chart

<table><tr><td>Hundreds</td><td>Tens</td><td>Ones</td></tr><tr><td>23</td><td>5</td><td>4</td></tr></table>b2. 23 hundred fifty four

c. I circled a group of 100 pennies. When I made 10 groups, I made a group of 1000 pennies and circled it with a big circle. I noticed there are two groups of 1000, three groups of 100, five groups of 10, and 4 more pennies.

d. Two groups of 1000 pennies make 2000 pennies. Three groups of 100 make 300. And then we have 54 more pennies.

How many groups of 100 pennies are there?

How many groups of 1000 pennies are there?

Why do you think we made groups of a thousand?</td>
<td>Help students recognize there are 23 groups of 100 pennies. (Students recognize this by listening to each other)

Remind students how we regrouped if there were more than 10 tens or 10 ones in the place value chart.

Help students recognize that when they make a group of a thousand, they do not need to go back and count again the number of hundreds. Also, it is easier to see the number by having two groups of 1000 instead of having 20 groups of 100.

Help students recognize there are 2 groups of 1000. Make sure all students see and circle the groups of 1000.

If students do the place value chart, ask if we’ve ever put two digits in one column--if there are more than ten 10s or 10 ones, we regroup...</td>
<td>Do students see the value of counting groups of objects?

Do students recognize there are 23 groups of 100 pennies?

Do students recognize that ten groups of a hundred make a different place value?

Do students see the groups of ten 100s that students used to make a thousand?

Do students see the value in counting by making a group of a thousand pennies?</td>
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<td>5. Summing up

We learned that ten groups of 100 make “one thousand and two groups of 1000 make “two thousand.” We can use groups of 1000 to count more quickly.

(Even though this is not our main goal, we feel that some students will view counting by using groups of 1000 as their main learning)

OR

Main Goal:</td>
<td>What did we learn about counting today?

What did you learn about making groups today?</td>
<td>Do students understand that our main learning point is that we can make a thousand using 10 hundreds, and a number with 2 groups of 1000 is two thousand?

Do students understand that the number made of two 1000s, three 100s, five</td>
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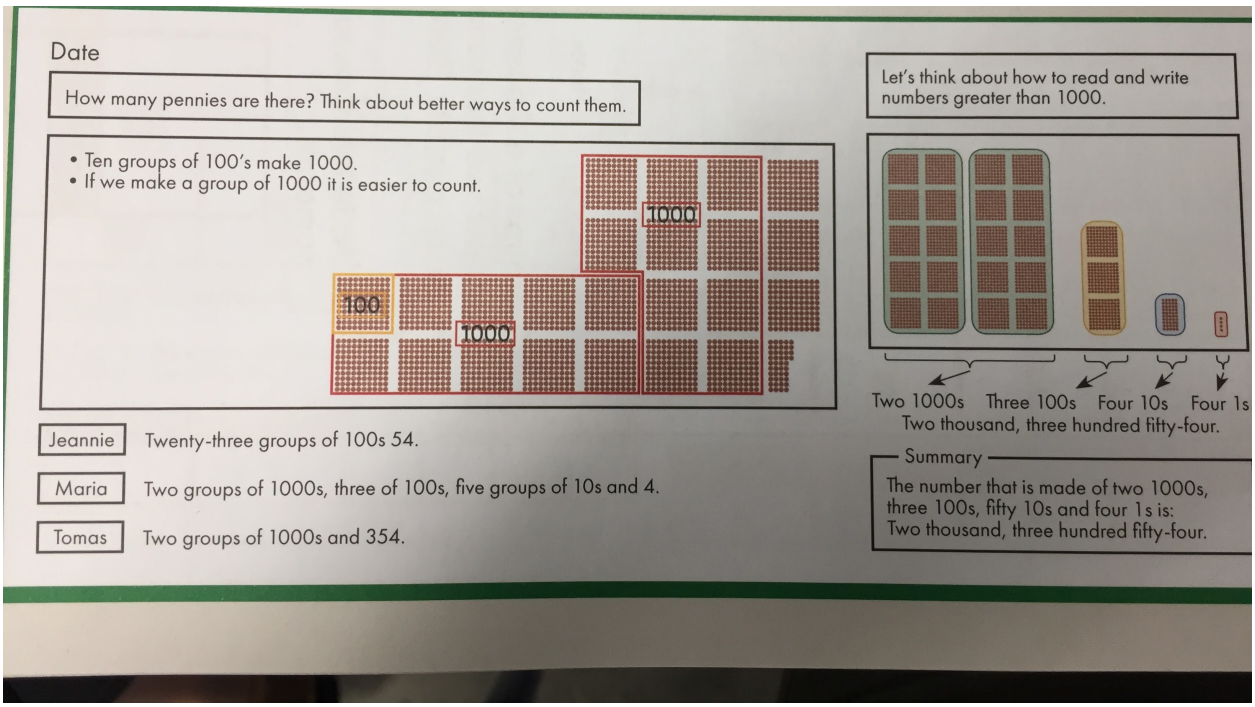
We learned that the number made of two 1000s, three 100s, five 10s, and four 1s is: Two thousand, three hundred fifty-four.		10s, and four 1s is: Two thousand, three hundred fifty-four.
6. Reflection **Today I learned…** **I notice that…** **My friend _____ taught me that…** **I made a mistake because…** **Next time I will...**		What are students writing as their new learning? What do students identify as a mistake or new learning?

10. Evaluation

For this lesson, we will use students' reflections to evaluate what students learned about the counting and thousands today. We will also use student work and teacher observations to answer the following questions:

- Related to research theme: Are students using mathematical language and models to describe and justify their thinking, as well as respond to, add on to, and critique the strategies of their peers?
- Related to lesson and unit goals:
    - Did students learn the structure of a 4-digit number and how to read these numbers (two thousand, three hundred fifty-four)?
    - Do students recognize that ten groups of 100 make "one thousand" and two groups of 1000 make "two thousand?"
    - Do students understand that putting "two thousand" and "three hundred fifty-four" together makes the number "two thousand three hundred fifty-four?"

11. Board Plan



There are a few changes to this board plan. First, we will have 3 additional large pictures of the pennies for comparing and discussing students' ways of counting. This way, students will be able to see a visual representation of the pennies and how their classmates counted and grouped them. Second, there are 5 tens (not 4 tens as the pictures erroneously indicate). Third, our summary statement will not say fifty 10s, it will say five 10s.

12. Post-lesson Reflection

This lesson taught us that second graders, when given the mathematical background necessary, can access numbers greater than 1,000. Although it's not a second grade standard, students with a strong foundation in the base-ten system and the ability to problem-solve were able to count above 1000 for the first time, and reason about how many pennies there were.

After the initial problem-solving time, there was not a single student who had counted the pennies exactly, but there were many students who counted in groups of 100, and a few students who found 2 groups of a thousand. From there, the students were able to discuss the best way to count, and why students had difficulty counting the total number of pennies. One point from the post-lesson discussion was that the discussion could have focused more on why counting past 1000 presented difficulty, and upon reflection I agree. If we had emphasized the reason it was difficult, students may have been better able to see the benefit of counting in groups of 1000. Still, the student presentation of ideas showed the students how counting by 1000 made finding the total number of pennies more efficient.

There was a large discussion of whether or not the teacher should have written the amount of pennies as a 4-digit number (2354) in addition to writing 2 thousands, 3 hundreds, 5 tens, and 4 ones. Ultimately, the teacher chose not to. A student did ask how to write it, and others were

clearly grappling with that, as well. At the time, though, it seemed that the most important new learning was not how to write a 4-digit number, but instead that 2 thousands, 3 hundreds, 5 tens, and 4 ones make two thousand three hundred and fifty-four. To the team's relief, Dr. Takahashi agreed, and emphasized the importance of patience. As we reflected on this lesson, we realized how tempting it can be to rush students along, tell them how to count the pennies, or just say to them that counting by thousands is better. This research lesson reminded us how important it is to be patient and let students struggle with, reason about, and discuss new mathematics with each other. When given the opportunity, all students can be successful in math.