Grade 1 Research Lesson Plan: Subtraction Using Subtrahend Decomposition
For the lesson on March 3, 2016
at Dr. Jorge Prieto Math and Science Academy
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Title of the Lesson: Let's Think About How to Calculate 12 minus 3

Brief description of the lesson:

Students will use their math blocks and their ten tray to think about how to calculate 12-3. Through a comparison and discussion of students' solutions, students will see the difference between using minuend decomposition and subtrahend decomposition to calculate subtraction problems.

Research Theme

Teach scholars to construct viable arguments and critique the reasoning of others *through note-taking, board work, and student discourse.*

Teach scholars to make sense of problems and persevere in solving them by *teaching mathematics through problem solving.*

Unit Goals

Students will understand calculations that involve regrouping when subtracting one digit numbers (subtrahends) from two digit numbers (minuends). Students will be able to calculate accurately using decomposition methods and will be able to apply decomposition methods to solving story problems.

Lesson Goal

Students will understand the subtrahend decomposition method for subtraction with regrouping when minuends are between 10 and 18 and subtrahends are single-digit numbers.

Relationship of the Unit to the Standards

Previous Grade	Current Grade	Next Grade
CCSS.MATH.K.OA.A.1 Represent addition and subtraction with objects, fingers, mental images, drawings, sounds (e.g., claps), acting out situations, verbal explanations, expressions, or equations. CCSS.MATH.K.OA.A.2 Solve addition and subtraction word problems,	CCSS.MATH.1.OA.A.1 Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem. CCSS.MATH.1.OA.B.3	CCSS.MATH.2.OA.A.1 Use addition and subtraction within 100 to solve one- and two-step word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using drawings and equations with a symbol for the unknown number to represent the

and add and subtract within 10, e.g., by using objects or drawings to represent the problem. CCSS.MATH.K.OA.A.3 Decompose numbers less than or equal to 10 into pairs in more than one way, e.g., by using objects or drawings, and record each decomposition by a drawing or equation (e.g., 5 = 2 + 3 and 5 = 4 + 1). CCSS.MATH.K.OA.A.4 For any number from 1 to 9, find the number that makes 10 when added to the given number, e.g., by using objects or drawings, and record the answer with a drawing or equation. CCSS.MATH.K.OA.A.5 Fluently add and subtract within 5.	Apply properties of operations as strategies to add and subtract. Examples: If 8 + 3 = 11 is known, then 3 + 8 = 11 is also known. (Commutative property of addition.) To add 2 + 6 + 4, the second two numbers can be added to make a ten, so 2 + 6 + 4 = 2 + 10 = 12. (Associative property of addition.) CCSS.MATH.1.OA.C.6 Add and subtract within 20, demonstrating fluency for addition and subtraction within 10. Use strategies such as counting on; making ten (e.g., 8 + 6 = 8 + 2 + 4 = 10 + 4 = 14); decomposing a number leading to a ten (e.g., 13 - 4 = 13 - 3 - 1 = 10 - 1 = 9); using the relationship between addition and subtraction (e.g., knowing that 8 + 4 = 12, one knows 12 - 8 = 4); and creating equivalent but easier or known sums (e.g., adding 6 + 7 by creating the known equivalent 6 + 6 + 1 = 12 + 1 = 13).	problem. CCSS.MATH.2.OA.B.2 Fluently add and subtract within 20 using mental strategies. By end of Grade 2, know from memory all sums of two one-digit numbers.

Background and Rationale

According to the CCSS-M for 1st grade, developing an understanding of addition and subtraction and strategies for computing addition and subtraction problems is a critical area of focus for instructional time. CCSS-M states that one important aspect of this expectation is that students use what they have already learned about 10 to make sense of subtraction by “decomposing a number leading to a ten (e.g., 13 - 4 = 13 - 3 - 1 = 10 - 1 = 9).”

Students have previously worked in kindergarten and in first grade with the base-ten system by composing and decomposing 10 (e.g., “10 is 9 and 1”, “8 and 2 makes 10”). They have learned to recognize and solve subtraction problems by subtracting one-digit numbers without regrouping by modeling the minuend with their blocks, removing the number of blocks represented by the subtrahend, and finding the number remaining by counting the remaining blocks or using their understanding of number composition and decomposition.

Moving from subtraction without regrouping to subtraction with regrouping is a challenge for our first graders. For example, in the problem 15 - 3, students only need to recognize that 15 is 10 and 5, and that 5 is 3 and 2, so 5 minus 3 is 2. The remaining 10 and 2 is 12. Even in this simple problem there is quite a bit of mathematics expected of the scholars. They need to know that 15 is 10 and 5, that 5 is 3 and 2, and that to find the final answer the have to combine the 10 and 2 to make 12. The mathematics involved with subtracting with regrouping makes this even more complex. In a problem such 13 - 9, students who use their previous understanding of base-ten

will break 13 into 10 and 3, and recognize that they cannot take 9 away from 3. They have to take the 9 away from the 10 and then remember to combine the 1 remaining with the 3 that was in the ones place of 13 to find the correct answer 4. This application of their previous experience with composing and decomposing numbers to make sense of these new types of problems, subtraction with regrouping, is a challenge for our students and serves as the rationale for exploring the topic through this research lesson plan.

Research and *Kyouzaikenkyuu*

According to the CCSS-M, a critical area of focus for first graders is for scholars to develop an understanding of addition, subtraction, and strategies for addition and subtraction within 20. The CCSS-M specifically states that students in first grade should use strategies such as counting on, making ten, and decomposing a number leading to a 10.

The English translation of the Japanese math book, Mathematics International, elaborates on the idea of "decomposing a number leading to a 10" in their unit on subtraction. Mathematics International describes the two decomposition methods that students can use to solve problems. Minuend decomposition in a problem such as 13-9 involves students recognizing that they cannot take 9 away from 3, so they split the minuend into 10 and 3, subtract 9 from 10 to get 1, and then add the 1 and 3 to get a final answer of 4. The subtrahend decomposition method in a problem such as 12-3 involves students seeing the minuend as 10 and 2 and then decomposing the subtrahend into 2 and 1, subtracting 2-2, and then subtracting the 1 from 10 to find an answer of 9.

Mathematics International goes on to explain that the goal for the unit on subtraction is for students to use semi-concrete objects, in this case counting blocks in ten-trays, to apply what they have learned previously about composing and decomposing numbers to make sense of regrouping and solving subtraction problems. Mathematics International stresses that for students to be able to develop multiple ways to subtract and explain their methods to others, it is important that they understand the underlying structure of numbers 11 through 19 as "ten and some more".

Mathematics International emphasizes that in order to understand subtraction with regrouping, students must understand the "ten and some more" structure of the minuend and manipulate counting blocks to show the decomposing and composing of numbers as they calculate. As they manipulate counting blocks to model the operation, students must also be able to communicate their ideas about the process of subtracting verbally and visually using diagrams, number sentences, and other types of notation. The task for the team is to design a unit that incorporates manipulation of blocks, use of diagrams, use of student notation, and verbal explanations *from students* to ensure at the end of the unit students have a solid understanding of subtraction strategies with regrouping to prepare them for subtraction with borrowing.

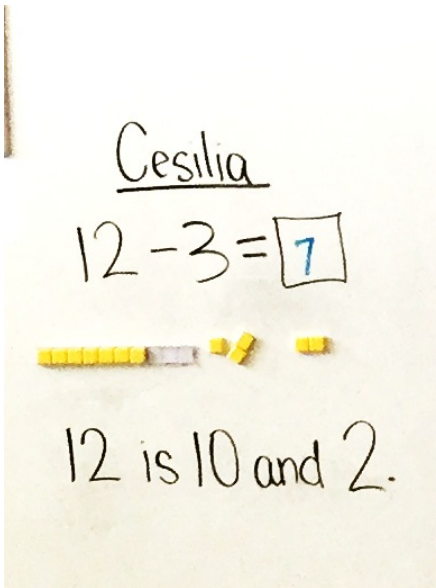
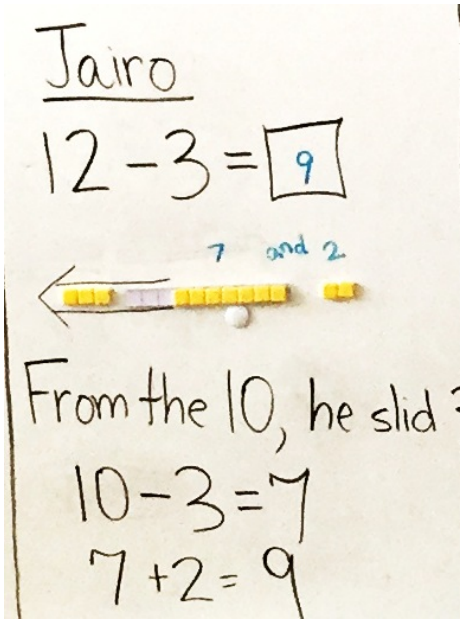
Flow of the Unit (Research Lesson in bold italics)

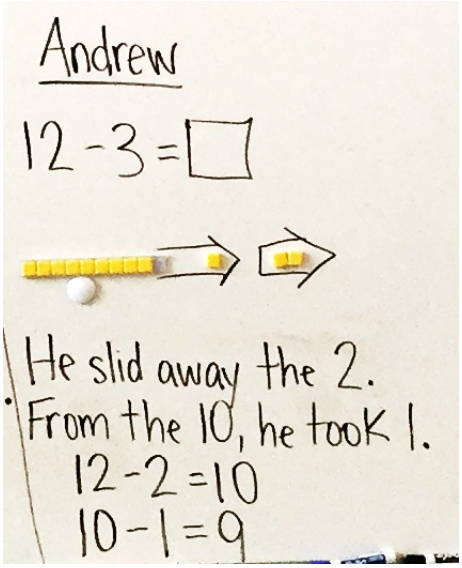
Day	Title	Goals
1	Unit 6 Lesson 1	Make the number sentence to match the story. 13-9
2	Unit 6 Lesson 2	"Let's think about how to calculate 13-9." Students compare counting method and minuend decomposition.
3	Unit 6 Lesson 3	Practice solving with subtrahend of 9.
4	Unit 6 Lesson 4	"Let's think about how to calculate 14-8, just as we did 13-9."
5	Unit 6 Lesson 5	Practice subtrahend 8 and 9.
6	Unit 6 Lesson 6	"Let's think about how to calculate 12-7" and practice subtrahend 7.
7	Unit 6 Lesson 7	Practice solving with subtrahend 6.
8	Unit 6 Lesson 8	Practice solving with subtrahend 5.
9	***Unit 6 Lesson 9***	***"Let's think about how to calculate 12 - 3". Students compare minuend and subtrahend decomposition methods.***

7. Flow of the Lesson

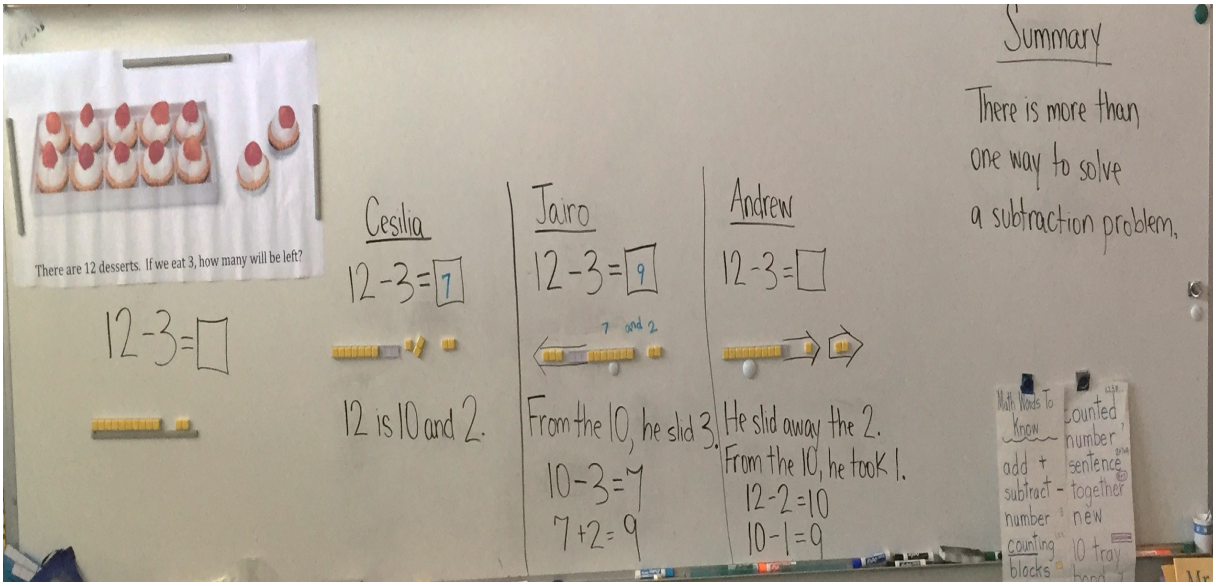
Teacher Questions/Support & Student Responses	Student and Teacher Actions	Points of Evaluation
1. Posing the Problem: 5-10 minutes There are 12 desserts. If we eat 3, how many will be left? *(Hay 12 postres. Si nos comemos 3, Cuantos quedaran? Piensa en como calcular esto.)* 	Have students discuss what number sentence goes with the story before they think about how to calculate. Have scholars discuss how to set up their blocks before they go back to their seats to work independently.	Are students able to create a number sentence that matches the picture? Are students able to represent the picture using their counting blocks?

2. Activity: 10 minutes Students think about how to calculate 12 - 3 using the counting blocks. **Anticipated Student Responses:** R1: Scholar counts out 12 blocks one at a time, takes away 3 blocks, and counts the 9 remaining blocks one at a time. R2: Scholar splits the 12 into 10 and 2, takes the 3 away from 10 and has a final answer of 7. Does not combine 7 with the 2 to make 9. R3: Scholar splits the 12 into 10 and 2, takes the 3 away from the 10 to get 7, 7 and 2 is 9. R4: Scholar splits the 3 into 2 and 1. Then subtracts the 2 from the 12 and gets 10. Then subtracts 1 from 10 and gets 9.	From where should we take away the 3? *(De donde le podemos quitar el 3?)* "You can't subtract 3 from 2, so…" *"No le podemos quitar 3 al 2, entonces…"*	Are students able to model the operation using blocks? Which scholars used minuend decomposition? Which scholars used subtrahend decomposition? Which scholars are still using counting methods and not using any base ten strategies?
3. Comparison and Discussion Scholars share their methods for calculating 12-3 and use blocks to communicate their ideas to the class. R2: Scholar shares that they know 12 is 10 and 2, so they took 3 away from 10 and got 7. *R2: El estudiante comparte que el sabe que 10 y 2 hacen 12, entonces al 10 le quito 3 y quedaron 7.* (5 minutes for sharing R2) Teacher asks student sharing to ask class if they have any questions or thoughts about their idea.	"I wonder what we are supposed to do with the 2 part of the 10 and 2 after we have taken 3 away from 10 and gotten 7?" *"Estoy pensando en que podemos hacer con el 2 del 10 después de que le quitemos el 3 al 10 y tengamos*	

 R3: Student shares that they split 12 into 10 and 2, then they took 3 away from 10 and got 7. 7 and 2 is 9. (minuend decomposition) *R3: El estudiante comparte que el dividio el 12 en 10 y 2, entonces al 10 le quito 3, y queda 7 y 2, entonces 7 y 2 es 9.* Teacher has student compare their solution to R2. R3: (5 minutes for sharing R3)  	*7?* Have students call on another student to paraphrase their friend's idea in their own words. Scholars that are presenting their idea are responsible for waiting until the class is attentive. "How did you know 10 - 7 is 3?" *"Como sabes que 10-7 es 3?"* "Because 10 is 7 and 3" "Porque el 10 es 7 y 3"	

R4: Student that used subtrahend decomposition shares their strategy. “I had to take away 3 so I took away the 2 from the 12 and 1 from the 10 and got 9.” *R4: Al 12 le quito 2, al 10 le quito 1 y quedaron 9.* (5 minutes for sharing R4)  The majority of time, 10-15 minutes, should be spent comparing R3 and R4 to have scholars understand that each student took the 3 away from a different part of the 12. R3 took the 3 away from the 10 and R4 took 2 away from the 2 and 1 away from the 10. The class discusses the similarities between the two solutions. They both split the 12 into 10 and 2, they both took 3 away, & they both got an answer of 9 remaining desserts. **Summary:** (10 minutes) “There are different ways to solve.” *“Hay diferentes maneras de resolver.”*		

8. Board Plan



9. Reflection Questions

How are scholars manipulating their blocks to make sense of the problem? How many are decomposing the minuend? the subtrahend?

How are scholars showing that they understand the structure of numbers 11 - 19 (“ten and some more”)?

How are scholars using diagrams and words to make their thinking known?

Are scholars able to explain their thinking in their notebooks, verbally in the comparison and discussion, and using blocks to show their friends their ideas?