

Research Lesson Proposal for Second Grade Solving for the Subtrahend

1. Title of the Lesson: *Solving for the Subtrahend*

2. Brief description of the lesson:

Students will solve a subtraction word problem in which the unknown quantity is in the change position (addend/subtrahend number). They will be expected to use the tape diagram as an aid to writing the appropriate number sentence and the math sentence used to solve for the unknown.

3. Research Theme

Construct viable arguments and critique the reasoning of others through note-taking, board work, and student discourse.

4. Goals of the Unit

- a) For students to become proficient in applying the relationship of addition and subtraction to solve problems with the unknown in any position.
- b) To help students understand that they can use the tape diagram as a tool to think about new situations and understand the relationship of the parts to the whole.
- c) Students will see the value in using the tape diagram and will use it as a tool to justify their own arguments and critique the reasoning of their peers.

5. Goals of the Lesson:

- a) Students will understand that they can use the inverse relationship of addition and subtraction to solve for the unknown in various positions.
- b) Students will be able to use the tape diagram accurately, write math sentences that match situations, and write math sentences that help them solve for the unknown in a more efficient manner.
- c) Students will see the value in using the tape diagram and will use it as a tool to justify their own arguments and critique the reasoning of their peers.



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6. Relationship of the Unit to the Standards

Portions of standards related to unit/lesson are in *italics*.

Related prior learning standards

1.OA.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.*

Learning standards for this unit

2.OA.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 problem.*

Related later learning standards

3.OA.8 *Solve two step problems using the four operations. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.*

7. Background and Rationale

According to Common Core State Standard 2.OA.1, by the end of 2nd grade students should be able to solve for the unknown in any position in a situation involving adding to, taking from, putting together, taking apart, and comparing in a word problem. The third grade Common Core assumes that the skill of solving for the unknown has been mastered and can be applied, now, to multiplication and division, as well (3.OA.D.8).

We have noticed that 2nd grade students in the past have been able to represent a problem with the unknown in any position for most addition and subtraction situations. Where they struggle is in the understanding and explanation of how they solved when the unknown is in any position other than the sum or the difference. We hypothesize that this struggle may stem from a lack of understanding of the relationship between addition and subtraction.

Research and Kyozaikenkyu

CCSS.Math.Content.2.OA.A.1 Represent and solve problems involving addition and subtraction:

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 problem.¹

As Van de Walle states, “Join and separate problems are the easiest for children to solve, but they need to be exposed to all types in order to understand the relationship of addition and subtraction. The join and separate problems for which the initial part is unknown are among the most difficult, and problems in which the change amounts are unknown are also difficult.” Our team’s plan is to create a unit that systematically addresses situational word problems and the placement of the unknown in a progressively complex order (join and separate--> change unknown--> initial unknown).

We made the decision to teach comparison problems in a separate unit later in the year because as Van de Walle explains comparison situations differ from other addition and subtraction situations because the third amount in the problem does not actually exist. When setting up a comparison situation students cannot think about it as parts and a whole as they can with other addition and subtraction situations.

In the Mathematics International Curriculum for second grade, different types of number stories and the 2.OA.1 learning standard are not addressed in an individual unit. Different types of world problems and addition and subtraction situations occur throughout the addition and subtraction units, but the new learning from these lessons focuses on calculation not reasoning through the problem. The curriculum uses a “tape diagram” as a tool for students to represent knowns and unknowns in different situations, but lacks opportunities for students to develop an understanding of the relationship between addition and subtraction with this tool.

We intentionally chose numbers and math sentences that would be solvable for the students at this point in the school year (no regrouping necessary and no numbers greater than 100) but that would force the students to recognize the need for the tool of the tape diagram to explain the math situations because the numbers are so large.

Unit Plan-

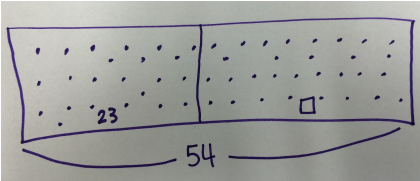
Lesson	Learning goal and tasks
1	Part-Part-Whole problem and introduce diagram. Ms. Eberle has 12 pumpkins. Of these pumpkins, 3 are orange and the rest are white. How many white pumpkins does Ms Eberle have? Share-outs- 1: row picture, 2: diagram, 3: diagram with number sentence/PPA
2	Unknown in all positions- introduce tape diagram; $? + 4 = 10$, $15 - ? = 8$; Launch: The kindergarteners are going to have a party. Their teachers remember how much fun you all are, so they asked us to help plan it. What are some things that they will need for their party? balloons, cookies, hot chips, taki, juice boxes, candy, pinata etc.
3	Join and Separate problems- practice using diagram; $48 + 11 = ?$, $64 - 21 = ?$ Ms Arnold was filling the pinata for the party. She put in 48 pieces of candy. Ms. Perlee added 11 more pieces. How many pieces of candy are in the pinata?

4	Practice day using tape diagrams - review days 1 and 2
5	Change unknown- addition; $25 + ? = 68$ Ms. Perlee bought 25 cookies for the party. Mrs. Garcia bought some more cookies for the party. Now, there are 68 cookies at the party. How many cookies did Mrs. Garcia buy? Write a math sentence that represents/tells the story and show how you solved. Summary: We can use a tape diagram to help us write a math sentence to solve the problem.
6	Initial unknown- addition; $? + 33 = 65$ Ms. Perlee bought some balloons for the party. Mrs. Arnold bought 33 more. Now there are 65 balloons. How many balloons did Ms. Perlee buy? Summary:
7	Practice day- review days 4 and 5
8	The research lesson: Change unknown- subtraction; $54 - ? = 23$
9	Practice- day 7
10	Initial Unknown; $? + 11 = 24$ Ms. Perlee picked out some songs to play at the party. Ms. Arnold chose 11 more songs. Now they are going to play 24 songs at the party. How many songs did Ms. Perlee pick for the party?
11	Practice- day 9
12-14	Practice all types/ assessment

8. Lesson Plan

Steps, Learning Activities Teacher's Questions and Expected Student Reactions	Teacher Support	Points of Evaluation
<p>1. Introduction: 5-10 min. "Ms. Perlee bought 54 balloons for the kindergarten party. Her class used some balloons to decorate her classroom. There are 23 balloons left for the Ms. Arnold's kindergarten class. How many balloons did Ms. Perlee's class use?"</p> <p>Students work to identify the knowns and unknown within the story. Class will generate the math sentence that matches the word problem.</p>	<p>The problem will be posted on the board.</p> <p>T: What are we solving for?</p>	<p>Can student pairs use the math sentence to retell the story?</p> <p>Are students able to listen, respond,</p>

		and critique each other's stories?				
<p>2. Posing the Task: 52min.</p> <p>“Ms. Perlee bought 54 balloons for the kindergarten party. Her class used some balloons to decorate their classroom. There are 23 balloons left for the other kindergarten classes. How many balloons did Ms. Perlee’s class use?”</p> <p>Task: How will we help Ms. Perlee figure out how many balloons her class used ?</p>	<p>The students will glue the problem into their student journals. Students will work independently in their math notebooks on solving the task. Teacher will monitor students as they work and choose students to share out at the board encouraging students to draw out the diagram and solve for the unknown.</p>					
<p>3. Anticipated Student Responses/ Student work time: 10 min.</p> <p>(We anticipate R1, R2, & R3 will be the most common responses, which is reflected in our anticipated board work; however, if R4 and/or R5 arise with any prevalence, the share-outs will be adjusted to reflect the needs within the class.)</p> <p>R1: $54 + 23 = \underline{\quad}$</p> <table border="1" data-bbox="201 1402 561 1472"> <tr> <td style="padding: 5px;">54</td> <td style="padding: 5px;">23</td> </tr> </table> $\begin{array}{r} 54 \\ + 23 \\ \hline 77 \end{array}$ <p>R2: Correct diagram and $23 + \underline{\quad} = 54$ or $54 - \underline{\quad} = 23$</p> <table border="1" data-bbox="201 1696 535 1766"> <tr> <td style="padding: 5px;">23</td> <td style="padding: 5px;"><input type="text"/></td> </tr> </table> <p>*for this response, we anticipate students either will get stuck or automatically write the vertical algorithm. At this point they may add or subtract with the math sentence written vertically.</p>	54	23	23	<input type="text"/>	<p>If students are stuck, teacher can prompt the student to use the tape diagram, and encourage looking back in the journal to previous days solutions and summaries.</p> <p>If students finish early teacher will prompt them to explain their solution in writing.</p>	<p>Are students using the tape diagram to represent the problem?</p> <p>How are students using the tape diagram to solve the problem?</p> <p>Are students using journal or anchor charts in the classroom to assist in solving the problem?</p>
54	23					
23	<input type="text"/>					

<p>R3: Correct diagram and $54 - \underline{\quad} = 23 \rightarrow 54 - 23 = \underline{\quad}$</p> <div style="text-align: center;"> <p>54</p> <table border="1" style="margin: auto;"> <tr> <td style="padding: 5px;">23</td> <td style="padding: 5px; text-align: center;">□</td> </tr> </table> </div> <p>*for this response, the goal is for students to understand that while one math sentence matches the story, the diagram can help us think through the problem in order to write a math sentence that can be solved easily.</p> <p>R4: $23 - \underline{\quad} = 54$</p> <p>R5: Draws a dot diagram to represent problem</p>  <p>R6: No response</p>	23	□		
23	□			
<p>4. Comparing and Discussing: 30</p> <p>R1: S shares out R1 at board. $54 + 23 = \underline{\quad}$</p> <p>R2: S shares out R2 at board.</p> <p>R3: S shares out number sentence</p>	<p>General questions: What does the 54 represent in our story? What does the 23 represent? What is the solve box? What words told us to add? What words told us to subtract? Let's use the tape diagram to check.</p> <p>R1T: This one doesn't match the story.*</p> <p>R2T: We're solving a part.*</p> <p>R3T: Not that we know this is the number sentence Used a diagram to solve.*</p>			
<p>(If needed, repeat 2, 3, & 4 above for additional tasks.)</p>				
<p>5. Summing up: 5-10 min.</p> <p>Diagrams help us think through a problem and write a math sentence that we CAN solve.</p>				

9. Evaluation

- Are the students making use of the diagram as a tool...
 - to make sense of the problem?
 - to aid in their explanation?
 - to aid in critique of other's ideas?
- What teacher moves are helping facilitate the students construction of their arguments and questioning of each other?

10. Board Plan

June = 6 / 9 / 2015
December = 12 / 14 / 2015

Ms. Perlee bought 54 balloons for the Kindergarten party. Her class used some balloons to decorate her classroom. There are 23 balloons left for Mrs. Arnold's class. How many balloons did Ms. Perlee's class use?

$$54 - \square = 23$$

This does not match the story.

This matches the story, but I can't solve it.

I can use a diagram to write a math sentence that I CAN solve.

$$\begin{array}{r} 54 \\ -23 \\ \hline 31 \end{array}$$