# Mathematics Instructional Cycle Guide

Three-Digit Subtraction (2.NBT.B7)

Created by Courtney Warner, 2014 Connecticut Dream Team teacher

## CT CORE STANDARDS

This Instructional Cycle Guide relates to the following *Standards for Mathematical Content* in the *CT Core Standards for Mathematics*:

**2.NBT.B.7** Add and subtract within 1000, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method. Understand that in adding or subtracting three-digit numbers, one adds or subtracts hundreds and hundreds, tens and tens, ones and ones; and sometimes it is necessary to compose or decompose tens or hundreds.

This Instructional Cycle Guide also relates to the following *Standards for Mathematical Practice* in the *CT Core Standards for Mathematics*:

**MP.3** - Construct viable arguments and critique the reasoning of others;

**MP.5** - Use appropriate tools strategically

## WHAT IS INCLUDED IN THIS DOCUMENT?

- A Mathematical Checkpoint to elicit evidence of student understanding and identify student understandings and misunderstandings **(pg. 2)**
- A student response guide with examples of student work to support the analysis and interpretation of student work on the Mathematical Checkpoint **(pgs. 3 - 6)**
- A follow-up lesson plan designed to use the evidence from the student work and address the student understandings and misunderstandings revealed **(pgs. 7 - 11)**
- Supporting lesson materials **(pgs. 12 - 15)**
- Precursory research and review of standard 2.NBT.B.7 and assessment items that illustrate the standard **(pgs. 16 - 17)**

## HOW TO USE THIS DOCUMENT

1) Before the lesson, administer the **Canned Food Drive Problem** ***Mathematical Checkpoint*** individually to students to elicit evidence of student understanding.
2) Analyze and interpret the student work using the ***Student Response Guide***
3) Use the next steps or ***follow-up lesson plan*** to support planning and implementation of instruction to address student understandings and misunderstandings revealed by the Mathematical Checkpoint
4) Make instructional decisions based on the checks for understanding embedded in the follow-up lesson plan

## MATERIALS REQUIRED

- **One dot, two dot, and three dot subtraction problem cards**
- **Subtraction Problems Using Two Strategies recording sheet**
- **Extension Task worksheet**
- **Student response white boards or scrap paper**

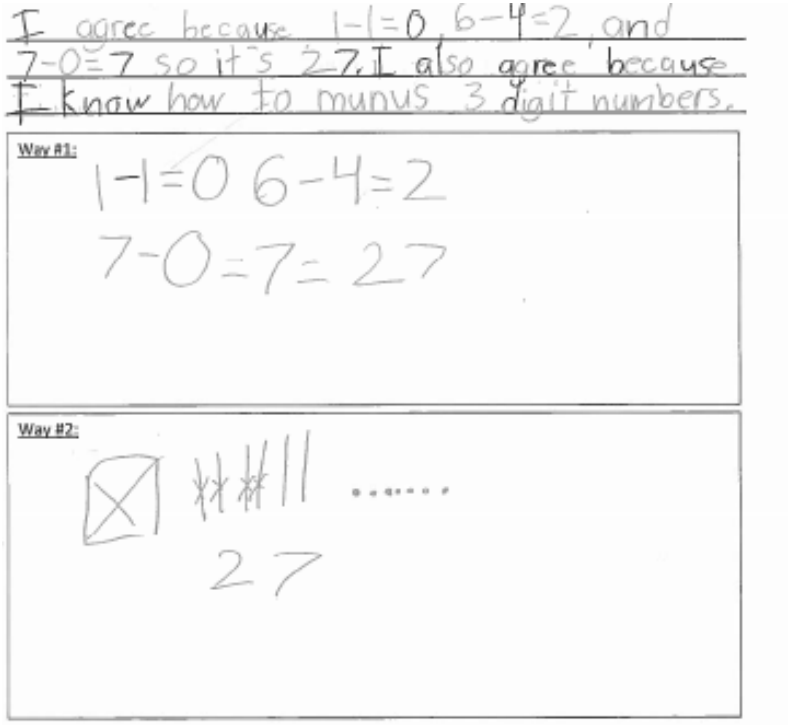
## TIME NEEDED

**Canned Food Drive Problem** administration: **15 minutes**
Follow-Up Lesson Plan: **60 minutes**

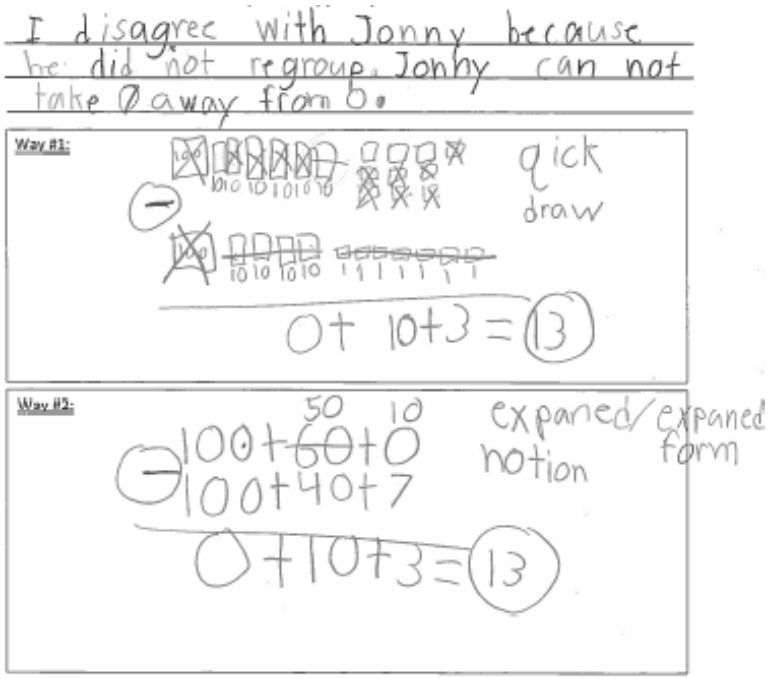
***Timings are only approximate. Exact timings will depend on the length of the instructional block and needs of the students in the class.***

<table>
<tr><th colspan="3">Step 1: Elicit evidence of student understanding</th></tr>
<tr><th colspan="3">Mathematical Checkpoint</th></tr>
<tr><th>Question(s)</th><th colspan="2">Purpose</th></tr>
<tr><td rowspan="2">Second grade is collecting cans for a canned food drive. We made a goal to collect 160 cans. We have collected 147 cans so far. How many more cans do we need to collect to reach our goal?<br><br>Jonny answered the problem like this: 160 – 147 = 27<br><br>Do you agree or disagree with Jonny? Why? Explain using words, pictures, and numbers. Show two ways to support your answer.</td><td>CT Core Standard:</td><td>2.NBT.B.7 Add and subtract within 1000, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method. Understand that in adding or subtracting three-digit numbers, one adds or subtracts hundreds and hundreds, tens and tens, ones and ones; and sometimes it is necessary to compose or decompose tens or hundreds.</td></tr>
<tr><td>Target question addressed by this checkpoint:</td><td>Can students solve a three-digit subtraction equation accurately?</td></tr>
</table>

| Step 2: Analyze and Interpret Student Work | | |
|---|---|---|
| Student Response Guide | | |
| **Got It** | **Developing** | **Getting Started** |
| I disagree with Jonny because he did not regroup. Jonny can not take 9 away from 6.<br>Way #1:<br>quick draw<br>0+10+3=13<br>Way #2:<br>100+60+0 (50, 10)<br>100+40+7<br>expaned/expaned notion form<br>0+10+3=13 | I disagree with Jonny. the real answer is 13.<br>Way #1:<br>13 | I agree because 1-1=0 6-4=2 and 7-0=7 so it's 27. I also agree because I know how to munus 3 digit numbers.<br>Way #1:<br>1-1=0 6-4=2<br>7-0=7=27<br>Way #2:<br>27 |

| Getting Started | |
|---|---|
| **Student Response Example** | **Indicators** |
|  | • Errors or misconceptions about subtraction with regrouping are revealed in the explanation and strategies shown (i.e. regrouping did not occur when drawing base ten blocks, decomposing, using the algorithm)<br>• Additional errors were made using the strategies (i.e. base ten blocks, open number line, decomposing, an algorithm)<br>• Student may not understand conceptual understandings of place value, explaining the answer as 1 – 1 = 0, 6 – 4 = 2 instead of 100 – 100 = 0 and 60 – 40 = 20<br>• Student may overgeneralize the commutative property of addition to subtraction that 0 – 7 = 7 because you can "turn" it to be 7 – 0 = 7<br>• Student may provide an explanation that describes incorrect mathematical understandings or gives an incomplete explanation. |
| **In the Moment Questions/Prompts** | **Closing the Loop (Interventions/Extensions)** |
| P: Explain your thinking on this strategy.<br>P: Draw a picture to show your thinking.<br>Q: How does your work show hundreds, tens, and ones?<br>Q: How do your two strategies relate? | • Show students how to trade one ten for ten ones using base ten blocks.<br>• Model how to show place value of numbers (expanded notation – i.e. 147 = 100 + 40 + 7)<br><br>http://learnzillion.com/lessons/4426-subtract-threedigit-numbers-with-base-ten-blocks<br><br>http://learnzillion.com/lessons/2978-subtract-threedigit-numbers-with-a-number-line |

| Developing | |
|---|---|
| **Student Response Example** | **Indicators** |
|  | • Student shows some understanding of three-digit subtraction with regrouping<br>• Student shows only one strategy accurately (i.e. base ten blocks, open number line, decomposing, an algorithm)<br>• Instead of subtracting, the student may have "counted up" using addition (i.e. 147 + ____ = 160) |
| **In the Moment Questions/Prompts** | **Closing the Loop (Interventions/Extensions)** |
| Q: Can you show another strategy to prove your answer?<br>Q: Why did you regroup one ten for ten ones? How did that help you solve this equation?<br>A: What do you think Jonny did wrong?<br>P: Label your work to show which strategy you're using. | • Use strategies the student is efficient with to develop other strategies<br>• Provide students with specific vocabulary and sentence frames to give better explanations<br>• Use additional "critiquing" opportunities for students to discover the errors and misconceptions of other student work samples<br>http://learnzillion.com/lessons/3119-explain-subtraction-using-place-value<br><br>http://learnzillion.com/lessons/3084-explain-subtraction-by-decomposing-numbers |

| Got it | |
|---|---|
| **Student Response Example** | **Indicators** |
|  | • Student effectively uses two different strategies to prove the correct answer is 13.<br>• Student may provide an appropriate explanation as to why Jonny's work was wrong (i.e. 0 – 7 doesn't equal 7, Jonny didn't regroup and was supposed to, or Jonny added 0 + 7 = 7)<br>• Student may label the responses with the strategies used (decomposing, open number line, picture/base ten blocks) |
| **In the Moment Questions/Prompts** | **Closing the Loop (Interventions/Extensions)** |
| A: What would you do to help Jonny understand his mistake? How would you teach him to do it correctly?<br>A: Would your strategy work for every three-digit problem? Would it work for numbers in the thousands? | • Students can be given three digit subtraction problems that require regrouping in the tens/hundreds as well as the ones/tens (i.e. 234 – 157 =)<br>• Students could be given problems in context.<br>• Students could justify the most efficient method for subtracting a given three-digit problem. |

| Steps 3 and 4: Act on Evidence from Student Work and Adjust Instruction | |
|---|---|
| **Lesson Objective:** | Students will subtract two three-digit numbers using an open number line. |
| **Content Standard(s):** | 2.NBT.B.7 – Add and subtract within 1000, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method. Understand that in adding or subtracting three-digit numbers, one adds or subtracts hundreds and hundreds, tens and tens, ones and ones; and sometimes it is necessary to compose or decompose tens or hundreds. |
| **Targeted Practice Standard :** | CCSS.Math.Practice.MP3 – Construct viable arguments and critique the reasoning of others. |

| Mathematical Goals | Success Criteria |
|---|---|
| • Understand how to use an open number line to subtract three digit numbers | • Use open number lines to subtract three digit numbers |

## Launch (Probe and Build Background Knowledge)

**Purpose: Reinforce number line concepts regarding number sense and value of numbers**

Students will refer to the number line in the classroom and teacher will reinforce number sense in relation to the number line. Give students a number (27) to find on the number line. Then ask where another number would go on the number line in relation to that number. For example: Where would the number 34 go? (to the right of 27 because it's greater). You could even make a "human number line" where you give each student a number and they have to put themselves in order from least to greatest (i.e. a number line).

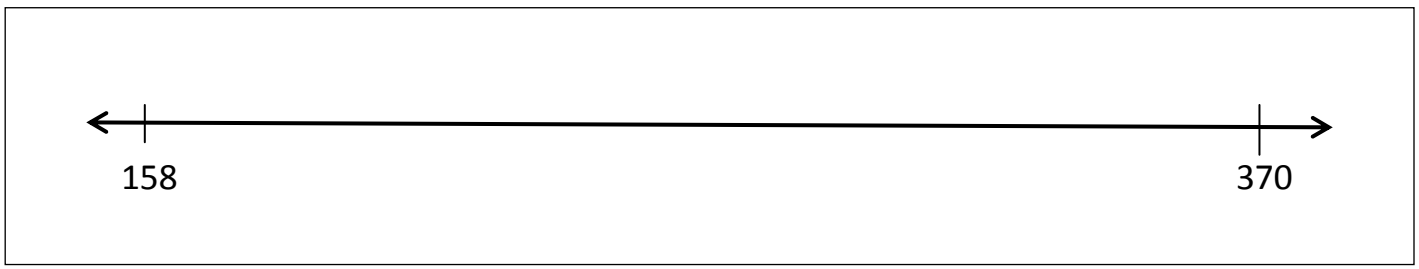
## Instructional Task

**Purpose: Re-introduce the open number line and how to place two 3-digit numbers on the number line based on the numbers' values.**

**Engage (Setting Up the Task)**

Write on the board 370-158 =. You already have strategies to solve this equation. Remind students of any strategies you've used thus far (base ten blocks, decomposing). Have students solve the problem using one of the strategies they've already learned and practiced. Elicit answers from students and have them explain their thinking. Then tell them that today we will use another strategy –open number line.

Our first step when using an open number line is to draw a blank number line. We then place a tick mark at the end and another at the other end. Teacher demonstrates the following below:



The two numbers we're working with are 370 and 158, so those are the numbers we need to place. Which number is less? (158) Do we place that on the left or the right side of our number line? (left) Turn and talk to your partner about why. (Because on a number line, the numbers get less as we go left and greater as we go to the right). Then we'll place 370 on the right.

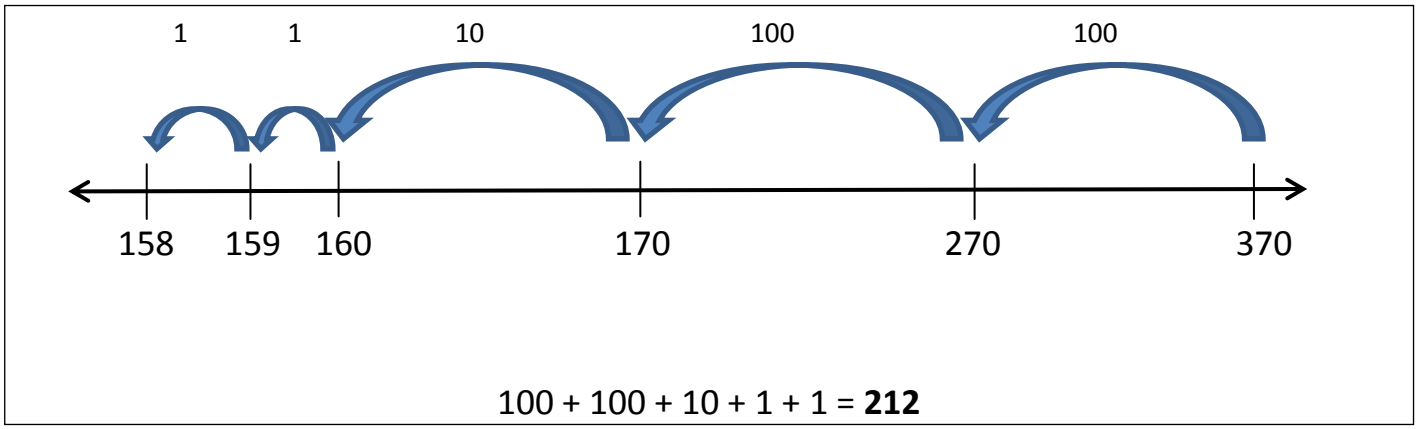
Now, if the problem we are solving is 370 – 158 =, we are looking for the DIFFERENCE between these two numbers. The difference between them in this case is the distance between them on this number line. In order to find that difference, we are not going to jump straight from 370 to 158. We are going to make smaller jumps – ones we can do in our heads.

That means we are going to try to make 10s or 100s – numbers we can work with easily using mental math.

**Emphasize with students that when using an open number line, we are NOT concerned with proportions. Also, know that there are many ways to subtract on an open number line, so there is no one way that's the "right" way.

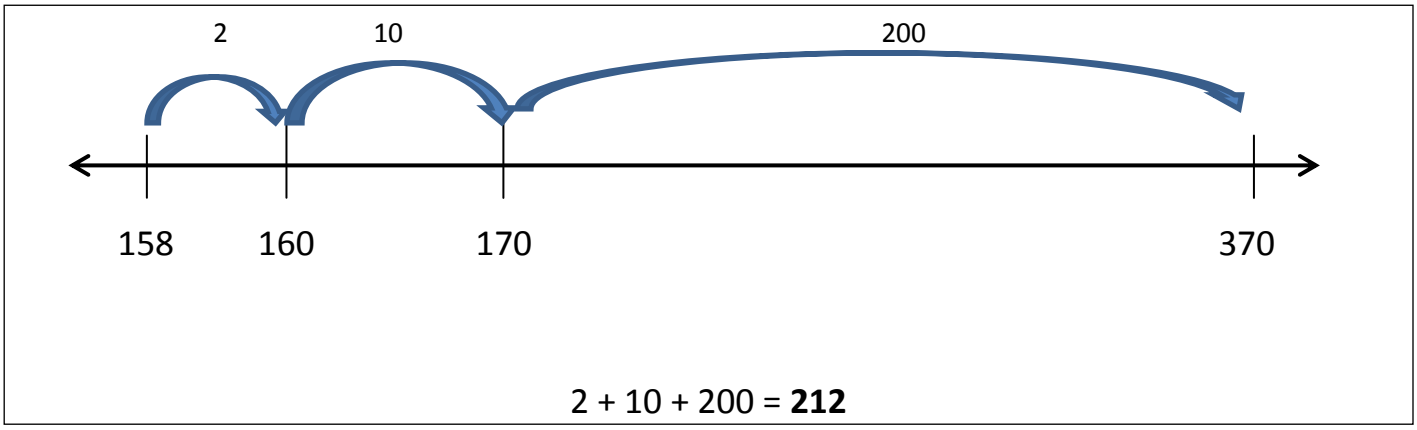
Elicit from students ideas of how they think they can jump the difference. Remind them to think of place value (hundreds, tens, and ones). Below is a possible example:

I can start with two jumps of 100 to get to 170, then I can do 1 jump of 10 to get to 160, then two jumps of 1 to get to 158. When I add up all my jumps, I find the difference, which is our answer.




100 + 100 + 10 + 1 + 1 = **212**

Another possibility for the same number line is that a student might "add up" to find the difference:




2 + 10 + 200 = **212**

Guided Practice: 460 – 138 =

Directions:

- Write an open number line with two end marks on it.
- Tell your partner which number is going to be written on which side of the line (460 on the right, 138 on the left). We're going to start at 460 and make logical jumps back until we get to 138.

Have students give you suggestions for the jump intervals.

Questioning:

- *Why did you make that jump of ____?*
- *Could we have made the jumps differently? How?*
- *How will we find the difference between 460 and 138? (Add up all the jumps).*

**Explore (Solving the Task)**

This activity is differentiated based on the results of the Check for Understanding below (*be sure to give this check for understanding before proceeding with this Explore task).

Students will choose task cards from cups marked as "one dot", "two dot", or "three dot". "One dot" problems involve a shorter difference requiring fewer jumps or problems requiring jumps only of hundreds or only of tens. "Two dot" problems are similar to the ones in the engagement activity. "Three dot" problems have greater differences requiring more or greater jumps.

Students will solve each problem using the open number line on a recording sheet. Then, they will check their answer using a previous strategy (base ten blocks, decomposing).

*Probing Questions:*

- *Explain your thinking.*
- *Why did you make ___ jumps of ____ (hundreds, tens, ones)?*
- *How do you know you counted the correct total number of jumps?*
- *Could you have made the jumps a different way? How?*

**Elaborate (Discuss Task and Related Mathematical Concepts)**

After each problem, students will collaborate with their partner to critique their work. *Do you agree or disagree with your partner's work? Why? Explain your reasoning.*

## Checking for Understanding

**Purpose: To check that students are able to correctly set up the problem, placing the numbers accurately on the number line.**

Give students one example to do on their whiteboards or scrap paper.

740 – 325 =

This check for understanding will determine how you differentiate the explore/pair activity to follow.

- If students could not set up the problem accurately (placing the numbers on the number line correctly), you should take them into a small group to reinforce how to set up the number line and place value concepts before assigning them the "one dot" problems in the explore part of the lesson
- Students who set up the problem correctly, but have some difficulty with the jumps would get the "two dot" problems.
- Students who solved the problem accurately, getting a correct answer and using the open number line appropriately will get the "three dot" problems.

## Common Misunderstanding

**Purpose: Make explicit the common mistake that students sometimes "over-jump" on the number line by simply looking at one place value (hundreds or tens) without looking at the other place values (tens or ones).**

Students may "over- jump". In the problem above, students may look at the hundreds and see there are 3 hundreds in 350 and 1 hundred in 178 and want to make 2 jumps of 100 since 2 is the difference between 3 and 1. This would be an "over-jump" which will get them to 170. They've gone too far, so they'll either get an answer of 100 + 100 = 200 or they'll try to "jump forward" back to 178 and add 8 more and get an answer of 208 which is also incorrect.

Explicitly state to students this misunderstanding if it does not arise naturally when reviewing the Check for Understanding. Tell them that a mistake many second graders often make is that they "over-jump" and demonstrate what it looks like when this happens.

## Checking for Understanding

**Purpose: Check that students can correctly solve a three-digit subtraction problem using the open number line and recognize the common misconception/misunderstanding.**

Exit slip – another "Jonny" problem. Poor Jonny doesn't understand how to use an open number line to solve three digit subtraction problems. On the slip, Jonny solves the problem incorrectly by "over-jumping" (the common misconception). Students will solve it correctly using the number line and explain why they think Jonny was incorrect.

## Closure

**Purpose: Gauge students' level of comfort using the open number line in comparison to previously taught strategies such as decomposing and base ten blocks.**

On the exit slip, students will also complete a "self-assess" asking to rate how they feel about each strategy they've learned so far. Teachers can use this to gauge how comfortable students are with the number line strategy. If other strategies all got smiley faces and the number line got a straight face or frown face, it is evident more work is needed teaching the number line strategy.

**Extension Task**

**Purpose: Students who have mastered the open number line strategy can be taught and practice the compensation strategy in regards to the open number line strategy.**

For students who show mastery of using the number line in this lesson or following this lesson, the teacher can take them into a small group briefly to demonstrate how understanding of compensation can be used on the number line. For example, with 427 – 199. Before placing the numbers on the number line, they can compensate the numbers to 428 – 200 and make the jumps quicker and easier. Plotting both of these problems on the same number line, one above the line and one below it, will help students to see that there is a constant difference of 228. Give students the extension task worksheet to practice this skill.

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# Extension Task

Name: _____

Compensate the numbers in the problem before using the open number line to solve.

*Example:* **351 – 196 =**

Compensate the subtrahend (the second number in the equation) to be a "friendly number".

**196 + 4 = <u>200</u>**

Then, adjust the minuend (the first number in the equation) to by the same amount (+4)

**351 + 4 = <u>355</u>**

Then solve the new equation: **355 – 200 =**

1. 400 – 198 =

2. 532 – 297 =

3. 741 – 595 =

Why does compensation work? When would you use the compensation strategy?

_____

_____

_____

Name _____

## Subtraction Problems Using Two Strategies

| Problem | Strategy 1 – Open Number Line | Strategy 2 – Your Choice |
|---|---|---|
| | | |
| | | |
| | | |

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| One Dot Problems | Two Dot Problems | Three Dot Problems |
| --- | --- | --- |
| ● 400 - 290 = | ●● 460 - 148 = | ●●● 914 - 258 = |
| ● 450 - 200 = | ●● 380 - 167 = | ●●● 823 - 477 = |
| ● 620 - 400 = | ●● 590 - 355 = | ●●● 734 - 189 = |
| ● 830 - 500 = | ●● 670 - 545 = | ●●● 855 - 386 = |

Name: _____

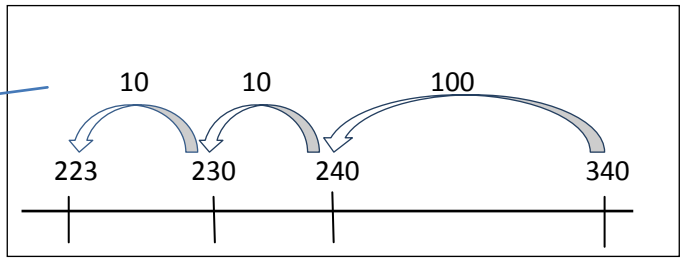
## Final Check for Understanding

Jonny used an open number line to solve 340 – 223 =

He showed his work like this:

100+10+10=120

340 – 223 = 120




Do you agree or disagree with Jonny? Why? Explain by checking Jonny's answer using an open number line and another strategy.

**Self-Assess**

How do you feel about using each of these strategies to solve three-digit subtraction?

1. Base Ten Blocks
2. Decomposing
3. Open Number Line

<table>
<tr><th colspan="2">Research and review of standard</th></tr>
<tr><th>Content Standard(s):</th><th>Standard(s) for Mathematical Practice:</th></tr>
<tr><td>Using place value understanding and properties of operations to add and subtract.<br><br>2.NBT.B.7 Add and subtract within 1000, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method. Understand that in adding or subtracting three-digit numbers, one adds or subtracts hundreds and hundreds, tens and tens, ones and ones; and sometimes it is necessary to compose or decompose tens or hundreds.</td><td>MP.3 Construct viable arguments and critique the reasoning of others<br>MP.5 Use appropriate tools strategically</td></tr>
<tr><th>Smarter Balanced Claim</th><th>Illustrative Mathematics Item</th></tr>
<tr><td>None</td><td>Pose this problem to the children:<br><br>We are in school 180 days. Today is the 124th day of school. How many more days until we are out of school for summer vacation? Explain how you know.<br><br>http://www.illustrativemathematics.org/illustrations/1063</td></tr>
<tr><td>CPR Pre-Requisites<br>(Conceptual Understanding, Procedural Skills, and Representations)</td><td colspan="2">Conceptual Understanding and Knowledge<ul><li>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</li><li>Understand that numbers can be represented in different ways such as 452 equals 3 hundreds, 15 tens, 2 ones or 4 hundreds, 4 tens, 12 ones.</li><li>Understand how to solve comparison of two parts as a “difference unknown” problem.</li><li>Understand that when adding 3 digit numbers, you add hundreds and hundreds, tens and tens, ones and ones, and sometimes it is necessary to compose or decompose tens or hundreds.</li></ul>Procedural Skills<ul><li>Add and subtract two-digit numbers</li></ul>Representational<ul><li>Create appropriate tools to solve 2-digit addition and subtraction problems such as open-number line, base ten blocks, decomposing or compensation.</li></ul>Social knowledge<ul><li>Know that you move right to left on a number line when subtracting and numbers decrease when going right to left</li><li>Know that a flat block equals 100, a tens rod equals 10, and a ones unit equals one.</li></ul></td></tr>
</table>

| Standards Progression | | |
|---|---|---|
| **Grade(s) below** | **Target grade** | **Grade(s) above** |
| **1.NBT.4** Add within 100, including adding a two-digit number and a one-digit number, and adding a two-digit number and a multiple of 10, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. Understand that in adding two-digit numbers, one adds tens and tens, ones and ones; and sometimes it is necessary to compose a ten.<br><br>**1.NBT.6** Subtract multiples of 10 in the range 10–90 from multiples of 10 in the range 10–90 (positive or zero differences), using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.<br><br>**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. | **2.NBT.1a** 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:<br>a. 100 can be thought of as a bundle of ten tens—called a "hundred."<br><br>**2.NBT.5** Fluently add and subtract within 100 using strategies based on place value, properties of operations, and/or the relationship between addition and subtraction.<br><br>**2.NBT.7** Add and subtract within 1000, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method. Understand that in adding or subtracting three-digit numbers, one adds or subtracts hundreds and hundreds, tens and tens, ones and ones; and sometimes it is necessary to compose or decompose tens or hundreds | **3.NBT.2** Fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction.<br><br>**4.NBT.4** Fluently add and subtract multi-digit whole numbers using the standard algorithm. |

| Common Misconceptions/Roadblocks |
|---|
| **What characteristics of this problem may confuse students?**<br>• *Students may have difficulty knowing whether to add or subtract.*<br><br>**What are the common misconceptions and undeveloped understandings students often have about the content addressed by this item and the standard it addresses?**<br>• *Students may think that if there are no tens or ones, you can't subtract.*<br><br>**What overgeneralizations may students make from previous learning leading them to make false connections or conclusions?**<br>• *Applying the commutative property of addition to subtraction as well. For example: 180 – 124 =, they would subtract 0 – 4 = 4 instead of regrouping a ten, ultimately getting an answer of 64 and not 56.* |