Whole Number Subtraction and Proofs

Objective: Subtract mixed numbers and use properties to prove the differences.

Standard: NS2.1

Prerequisites: Adding numbers and decimals

Subtracting numbers on a number line with two column proofs

Part 1: the number line

Problem: 57 – 18

See example below. Start by drawing a line. "What is this?"
[A line] (You may get responses like 'a number line'. Clarify that it needs numbers to be a number line.)
"We get the numbers for the line from the problem. The lower number is the start of the line, on the left side, and the greater number is the end of the line, on the right side. What is the lower number?"
[18]

"What is the greater number?"
[57] "Write this at the end of the number line"

"Let's fill in the tens in between the numbers. What is the tens after 18?
[20]

"And after 20?"
[30]

Use choral response to engage kids and mitigate potential problems.

"Then?"
[40]

"And?"
[50]

"Would we write 60 on our number line?
[No, because 60 is greater than 57]

"Find the distance between each of the numbers. What is the distance between each of the tens?"
[10]

"Let's label them."
"What is the distance between 50 and 57?"
[7]

"What is the distance between 18 and 20?"
[2]

Part 2: the expression and two column proof

See example below. "Now we need to combine our partial differences. We are also going to draw a column to show our math actions and properties that we use to solve the problem. What are we going to add?"
[2 + 10 + 10 + 10 + 7]

"When we write numbers, the tens place is first, so I am going to use the Commutative Property of Addition to rearrange my numbers to add the tens first because they are alike. What should I write?"
[10 + 10 + 10 + 2 + 7]

"I will also write the property in the column to the right. I can now combine like terms, and write that in the column. I can combine the tens, can I combine the ones?"
[yes]

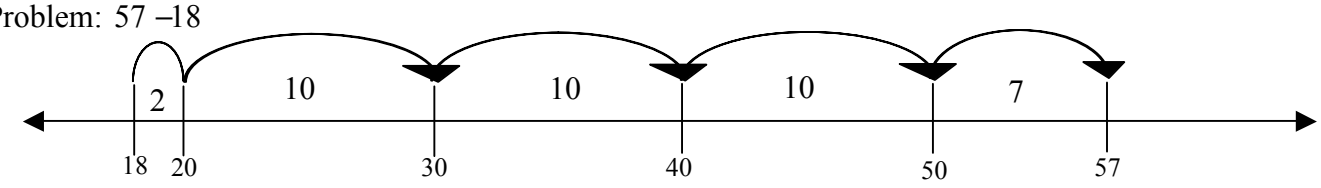
"What is the value for my tens?"
[30]

"What is the value for my ones?"
[9]

"What is my expression now?"
[30 + 9]

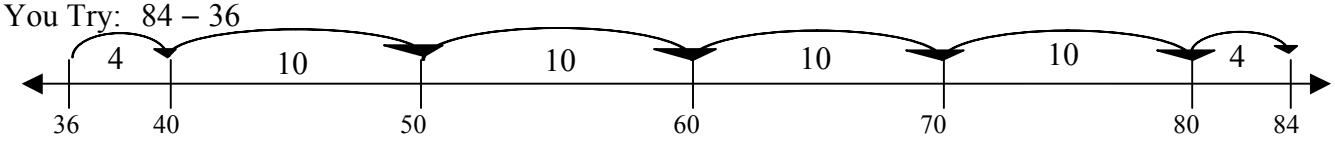
"Now we can simplify our expression by putting the 30 and 9 together to get 39."

Problem: 57 –18



= 2 + 10 + 10 + 10 + 7	
= (10 + 10 + 10) + (2 + 7)	Commutative property of addition
= 30 + 9	Combine like terms
= 39	Simplify

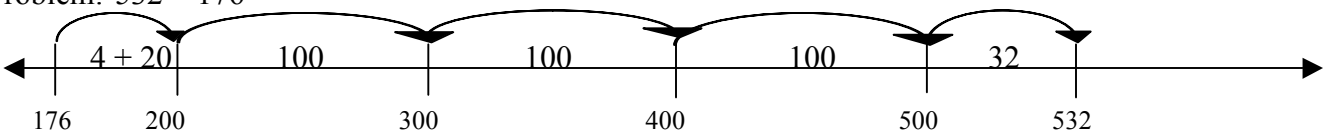
You Try: 84 – 36



= 4 + 10 + 10 + 10 + 10 + 4	
= (10 + 10 + 10 + 10) + (4 + 4)	Commutative Property of Addition
= 40 + 8	Combine like terms
= 48	Simplify

Now lets try larger numbers…

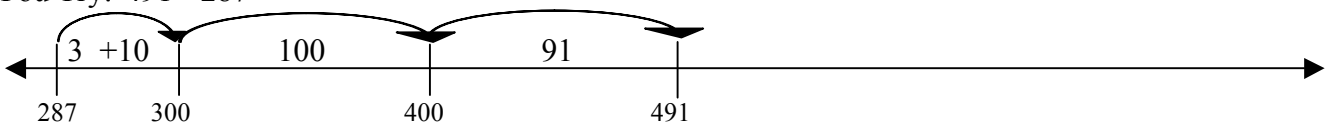
Problem: $532 - 176$



$= 24 + 100 + 100 + 100 + 32$	
$= 20 + 4 + 100 + 100 + 100 + 30 + 2$	Decompose
$= (100 + 100 + 100) + (20 + 30) + (4 + 2)$	Commutative property of addition
$= 300 + 50 + 6$	Combine like terms
$= \boxed{356}$	Simplify

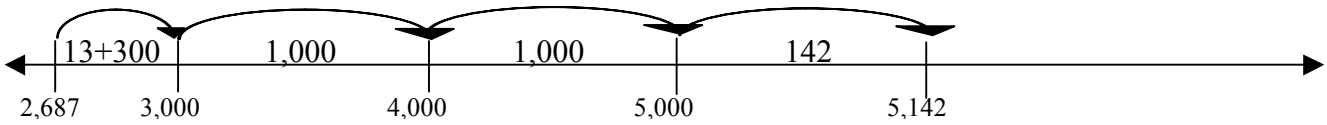
For the You Try let students find the difference on the number line in any way that makes sense to them. Have them share with each other how they determined the distance between the numbers. Then when they are writing up their expressions and proofs look for kids to come up and debrief the problem in different ways. This debrief allows students to see it in more ways.

You Try: $491 - 287$



$= 13 + 100 + 91$	
$= 10 + 3 + 100 + 90 + 1$	Decompose
$= 100 + (10 + 90) + (3 + 1)$	Commutative property of addition
$= (100 + 100) + 4$	Combine like terms
$= 200 + 4$	Combine like terms
$= \boxed{204}$	Simplify

Problem: $5{,}142 - 2{,}687$



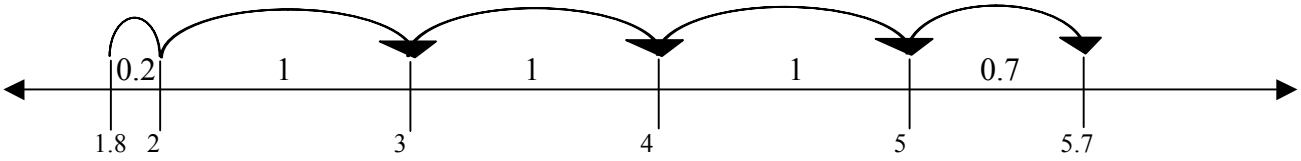
$= 313 + 1{,}000 + 1{,}000 + 142$	
$= 300 + 10 + 3 + 1{,}000 + 1{,}000 + 100 + 40 + 2$	Decompose
$= (1{,}000 + 1{,}000) + (300 + 100) + (10 + 40) + (3 + 2)$	Commutative property of addition
$= 2{,}000 + 400 + 50 + 5$	Combine like terms
$= \boxed{2{,}455}$	Simplify

Have students work together to complete the you try. Get them to share their thought process on how they found the differences between these numbers.

You try: $3{,}532 - 1{,}836$

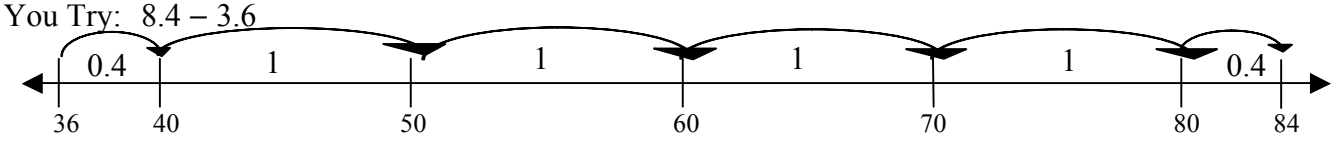
$= 164 + 1{,}000 + 532$	
$= 100 + 60 + 4 + 1{,}000 + 500 + 30 + 2$	Decompose
$= 1{,}000 + (100 + 500) + (60 + 30) + (4 + 2)$	Commutative property of addition
$= 1{,}000 + 600 + 90 + 6$	Combine like terms
$= \boxed{1{,}696}$	Simplify

And onto decimals…
Problem: $5.7 - 1.8$



$= 0.2 + 1 + 1 + 1 + 0.7$	
$= (1 + 1 + 1) + (0.2 + 0.7)$	Commutative property of addition
$= 3 + 0.9$	Combine like terms
$= \boxed{3.9}$	Simplify

You Try: $8.4 - 3.6$



$= 0.4 + 1 + 1 + 1 + 1 + 4$	
$= (1 + 1 + 1 + 1) + (0.4 + 0.4)$	Commutative Property of Addition
$= 4 + 0.8$	Combine like terms
$= \boxed{4.8}$	Simplify

Subtracting Mixed numbers on a number line with two column proofs

Part 1: the number line

Problem: $5\frac{2}{3} - 2\frac{1}{5}$

See example below. Start by drawing a line. "What is this?"
[A line] (You may get responses like 'a number line'. Clarify that it needs numbers to be a number line.)
"We get the numbers for the line from the problem. The lower number is the start of the line, on the left side, and the greater number is the end of the line, on the right side. What is the lower number?"

[$2\frac{1}{5}$]

"What is the greater number?"

[$5\frac{2}{3}$] "Write this at the end of the number line"

"Let's fill in the whole numbers in between the mixed numbers. What is the whole number after $2\frac{1}{5}$?

[3]

"And after 3?"
[4]

"Then?
[5]

"Would we write 6 on our number line?

[No, because 6 is greater than $5\frac{2}{3}$]

"Find the distance between each of the numbers. What is the distance between each of the whole numbers?"
[1]
"Let's label it."

"What is the distance between 5 and $5\frac{2}{3}$?"

[$\frac{2}{3}$]

"What is the distance between $2\frac{1}{5}$ and 3?"

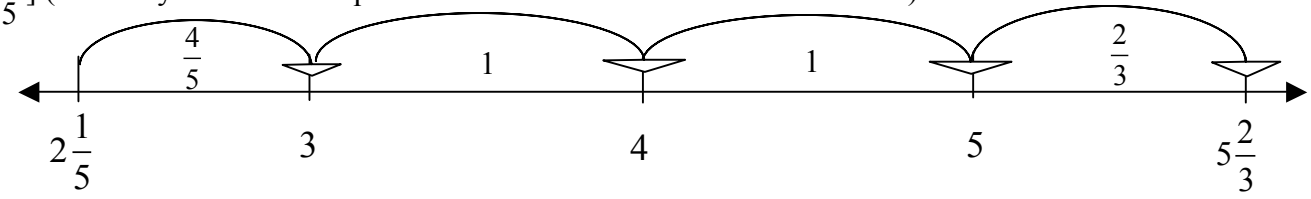
[$\frac{4}{5}$] (You may need to do a quick mini-lesson to show how to solve this)

Mini-lesson:

$2\frac{1}{5} + \square = 3$

$2\frac{1}{5} + \square = 2 + 1$

$2\frac{1}{5} + \frac{4}{5} = 2 + \frac{5}{5}$



Part 2: the expression and two column proof

See example below. "Now we need to combine our partial differences. We are also going to draw a column to show our math actions and properties that we use to solve the problem. What are we going to add?"

$[\frac{4}{5}+1+1+\frac{2}{3}]$

"When we write mixed numbers, the whole numbers is first, so I am going to use the Commutative Property of Addition to rearrange my numbers to add the whole numbers first. What should I write?"

$[1+1+\frac{4}{5}+\frac{2}{3}]$

"I will also write the property in the column to the right. I can now combine like terms, and write that in the column. I can combine the whole numbers, can I combine the fractions?"

[no, they need common denominators]

"What is the common denominator for these fractions?"

[15]

"What do I multiply $\frac{4}{5}$ by to get a denominator of 15?"

$[\frac{3}{3}]$

"What do I multiply $\frac{2}{3}$ by to get a denominator of 15?"

$[\frac{5}{5}]$

"We would list that math action as find a common denominator. What is our expression now?"

$[1+1+\frac{12}{15}+\frac{10}{15}]$

"Since the fractions are like terms, we can combine them. What is $\frac{12}{15}+\frac{10}{15}$?

$[\frac{22}{15}]$

"Now we simplify it , and write simplify in the column next to it, by changing it to a mixed number. What is it now?"

$[1+\frac{7}{15}]$

"We need to combine the like terms again, so add the whole numbers. What is our final answer?"

$[3\frac{7}{15}]$

"Is it in simplest form?"

[yes]

Example:
Problem:

$= \frac{4}{5} + 1 + 1 + \frac{2}{3}$	Math Actions:
$= \left(1 + 1\right) + \frac{4}{5} + \frac{2}{3}$	Commutative Property of Addition
$= 2 + \left(\frac{4}{5} \times \frac{3}{3}\right) + \left(\frac{2}{3} \times \frac{5}{5}\right)$	Combine like terms
$= 2 + \left(\frac{12}{15} + \frac{10}{15}\right)$	Find common denominators
$= 2 + \frac{22}{15}$	Combine like terms
$= \left(2 + 1\right) + \frac{7}{15}$	Simplify
$= 3\frac{7}{15}$	Combine like terms