Subtracting with Multi-Digit Numbers
Adaptable for 2nd, 3rd, 4th, and 5th grades*

*Please note that this lesson will be most effective after students have been taught a conceptual foundation in subtraction using Base-10 Blocks and the Build It → Draw It → Write It model.

Objective: Students will be able to solve subtraction problems, including subtracting across zeroes, using a variety of methods, including open number lines, decomposition, and the traditional algorithm.

Direct Instruction/ Teacher Model/ I Do

Write on board:
$$\begin{array}{r} 1000 \\ -\ 647 \\ \hline \end{array}$$

Many of you take a look at a problem like this and get scared. Today we're going to look at this problem and show you three different ways that you could solve it. By the end of the lesson, subtracting larger numbers – even if they have a lot of zeros in them – will no longer scare you.

Open Number Line
The first way that we are going to solve this problem is using an 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 one end and another at the other end.

The two numbers we are working with are 1000 and 647, so those are the numbers that we need to place. Which is the smaller of those numbers? [647]   *Do we place that on the left or the right side of our number line?* [On the left.] *Tell your partner why.* [Because on a number line, numbers get smaller as we go to left and larger as we go to the right.] *Then we'll place 1000 on the right.*
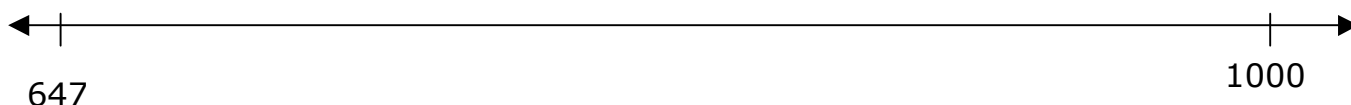
Now if the problem that we are solving is 1000 – 647, we are looking for the <u>difference</u> between these two numbers. And the difference between them in this case is the distance between them on this number line. In order to find that difference, we are not going to jump straight from 647 to 1000; we are going to make smaller jumps, ones that we can do in our heads. That means that we are going to try to make easy 10's or easy 100's – numbers that we can work with easily using mental math.

Emphasize with the students that when using an open number line, we are <u>not</u> concerned with proportions. Also, know that there are many ways to subtract on an open number line, so there is no one way that is the "right" way.

I know that to get from 647 to 650 is making a jump of 3. From 650, I know that jumping 50 more will get me to 700. I can jump another 100 to 800, then another 100 to 900, and then another 100 to 1000. I also could have gone straight from 700 to 1000 because I know that's a jump of 300.
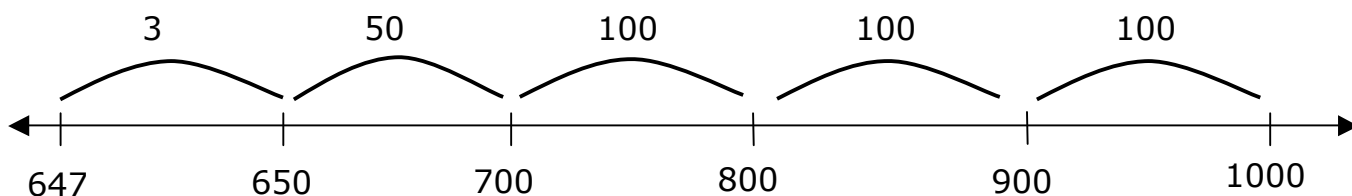
From looking at my open number line, I can see that the difference between 1000 and 647 is 3 + 50 + 100 + 100 + 100, or 353.

Other possibilities for the same number line:
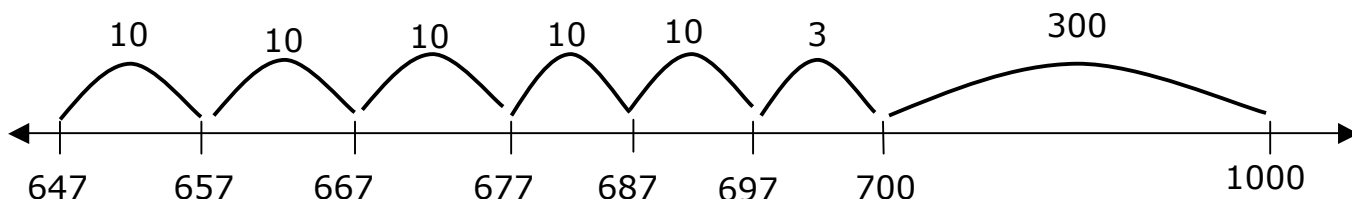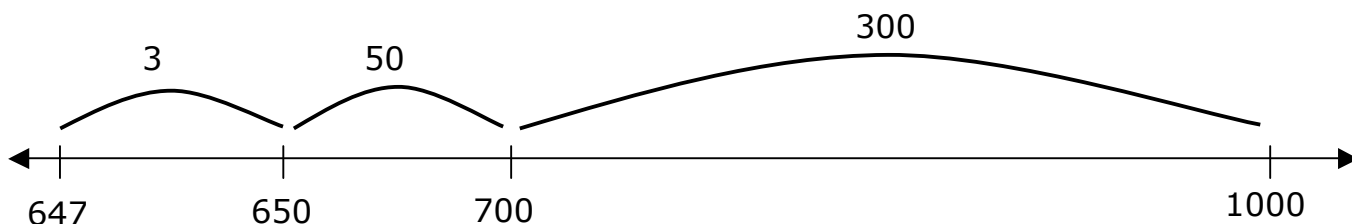
Decomposition

When we're faced with a problem that scares us, one thing we can do is look for a way to break it down into problems that are easier for us to solve. That's where decomposition comes in. If trying to subtract 647 from 1000 is hard for me, I'm going to find a way to subtract 647 from something that isn't as hard for me.

$$\begin{array}{r} 1000 \\ -\ 647 \\ \hline \end{array}$$

$$\begin{aligned} &999 + 1 \\ -\ &647 \\ \hline =\ &352 + 1 \\ =\ &353 \end{aligned}$$

I can decompose 1000 into 999 + 1.

Then I subtract the 647 from 999.

Then I cannot forget to recompose the 1.

Traditional Algorithm

We should still be able to solve this using the traditional algorithm. One reason to save this one for last is that since we have now solved our problem twice, we can check our answer right away to confirm if we used the traditional algorithm correctly.

$$\begin{array}{r} \overset{9}{\cancel{10}}\ \overset{9}{\cancel{10}}\ 10 \\ \cancel{1}\cancel{0}\cancel{0}\cancel{0} \\ -\ 647 \\ \hline 353 \end{array}$$

- *In the ones place, I have 0 minus 7. Since that will give me a negative number, I will try to regroup from the tens place.*
- *In the tens place, I have a 0 and therefore no tens from which to regroup. I will try to regroup from the hundreds place.*
- *In the hundreds place, I have a 0 and therefore no hundreds from which to regroup. I will try to regroup from the thousands place.*
- *In the thousands place, I have 1 thousand which I will regroup into 10 hundreds. That will leave me with 0 thousands and 10 hundreds. But I still don't have ones with which to subtract.*
- *So now that I have 10 hundreds, I will regroup one of them into 10 tens. That will leave me with 9 hundreds and 10 tens. But I still don't have ones with which to subtract.*
- *So now that I have 10 tens, I will regroup one of them into 10 ones. That will leave me with 9 tens and 10 ones.*
- *Now I can subtract 7 ones from 10, which gives me 3 ones.*
- *I can subtract 4 tens from 9, which gives me 5 tens.*
- *I can subtract 6 hundreds from 9, which gives me 3 hundreds.*
- *And I have no thousands.*
- *The difference is 353.*

Once you have determined that you arrived at the same answer all three ways, then you can use the inverse operation to check your answer: $353 + 647 = 1000$

Guided Instruction/ We Do

Example: $\begin{array}{r} 3005 \\ -\ 1879 \end{array}$

Open Number Line

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 number line. [1879 on the left, 3005 on the right] *We're going to start at 1879 and make logical jumps until I get to 3005.*

Have the students give you suggestions for the size of the jumps. Below is one way to solve the problem.
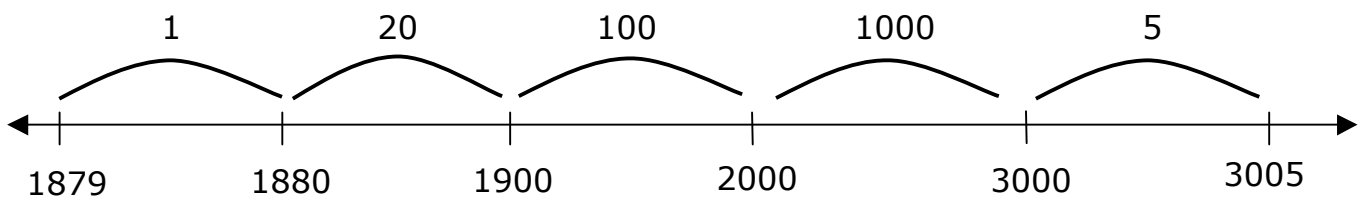
How will we find the difference between 3005 and 1879? [We will add up all of our jumps.]

$$\begin{array}{r} 1 \\ 20 \\ 100 \\ 1000 \\ +\ \ \ 5 \\ \hline 1126 \end{array}$$

Decomposition

$\begin{array}{r} 3005 \\ -\ 1879 \\ \hline \end{array}$ $=$

$2999+1+5$ *I can decompose 3005 into 5 + 2999 + 1.*

$-\ 1879$ *Then I subtract the 1879 from 2999.*

$=\ 1120+1+5$ *Then I cannot forget to recompose the 5 and the 1.*

$=\ 1126$

We know that there are different ways to decompose. What is another way in which you could you decompose 3005 to help you solve this problem? [2999 + 6]

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Traditional Algorithm

$$\begin{array}{r} \overset{\;\;\;\;\;\overset{9}{\cancel{10}}\;\overset{9}{\cancel{10}}}{\overset{2\;\;\cancel{10}\;\cancel{10}\;15}{\cancel{3}\cancel{0}\cancel{0}\cancel{5}}} \\ -\;1879 \\ \hline 1126 \end{array}$$

- *In the ones place, I have 5 minus 9. Since that will give me a negative number, I will try to regroup from the tens place.*
- *In the tens place, I have a 0 and therefore no tens from which to regroup. I will try to regroup from the hundreds place.*
- *In the hundreds place, I have a 0 and therefore no hundreds from which to regroup. I will try to regroup from the thousands place.*
- *In the thousands place, I have 3 thousands from which I will take 1 and regroup it into 10 hundreds. That will leave me with 2 thousands and 10 hundreds. But I still don't have ones with which to subtract.*
- *So now that I have 10 hundreds, I will regroup one of them into 10 tens. That will leave me with 9 hundreds and 10 tens. But I still don't have ones with which to subtract.*
- *So now that I have 10 tens, I will regroup one of them into 10 ones. That will leave me with 9 tens and 10 ones to add to my existing 5 ones. That leaves me with 15 ones.*
- *Now I can subtract 9 ones from 15, which gives me 6 ones.*
- *I can subtract 7 tens from 9, which gives me 2 tens.*
- *I can subtract 8 hundreds from 9, which gives me 1 hundred.*
- *I can subtract 1 thousand from 2, which gives me 1 thousand.*
- *The difference is 1126.*

Once you have determined that you arrived at the same answer all three ways, then you can use the inverse operation to check your answer: $1126 + 1879 = 3005$

You Try

*There are many different possibilities for the solutions with open number lines and with decomposition. These are simply one example.
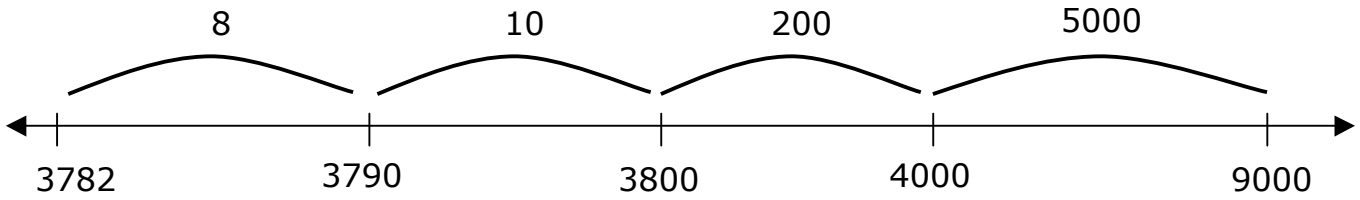
4100 – 1975
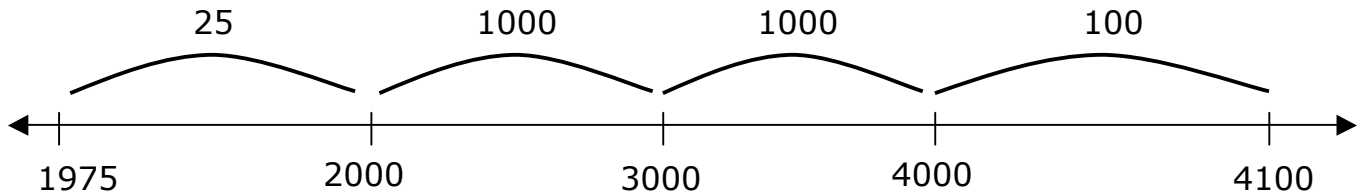
$$\begin{array}{r} 25 \\ 1000 \\ 1000 \\ +\ \ 100 \\ \hline 2125 \end{array}$$

$$\begin{array}{r} 4100 \\ -\ 1975 \\ \hline \end{array}$$

$$=\ \begin{aligned} & 3999+1+100 \\ & -1975 \\ \hline & =\ 2024+1+100 \\ & =\ 2125 \end{aligned}$$

$$\begin{array}{r} \overset{3}{\cancel{4}}\overset{10\ \ 9}{\cancel{1}}\overset{10}{\cancel{0}}\overset{10}{\cancel{0}} \\ -\ 1975 \\ \hline 2125 \end{array}$$

You Try (continued)

9000 − 3782

$$
\begin{array}{cccc}
\overset{8}{} & 10 & 200 & 5000 \\
\end{array}
$$

3782   3790   3800   4000   9000

$$
\begin{array}{r}
8 \\
10 \\
200 \\
+\;\; 5000 \\
\hline
5218 \\
\end{array}
$$

$\begin{array}{r} 9000 \\ -\;3782 \\ \end{array}$ $\begin{array}{rl} & 8999+1 \\ & -\;3782 \\ \hline = & 5217+1 \\ = & 5218 \\ \end{array}$	$\begin{array}{r} \overset{8\;\;\overset{9}{10}\;\overset{9}{10}\;10}{\cancel{9000}} \\ -\;3782 \\ \hline 5218 \\ \end{array}$

Independent Practice/ You Do

502 - 273 _____

Number line from 273 to 502 with jumps labeled 7, 20, 200, 2, and points at 273, 280, 300, 500, 502.
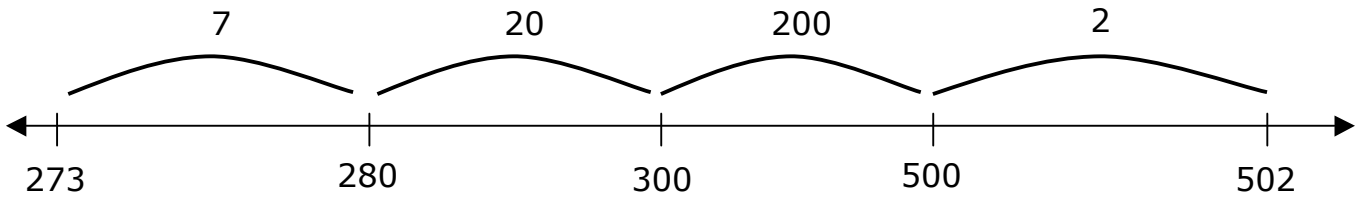
$$
\begin{array}{r}
7 \\
20 \\
200 \\
+\ \ 2 \\
\hline
229
\end{array}
$$

$\begin{array}{r} 502 \\ -\ 273 \\ \hline \end{array}$ = $\begin{array}{l} 499 + 1 + 2 \\ -\ 273 \\ \hline = \ 226 + 1 + 2 \\ = \ 229 \end{array}$	$\begin{array}{r} \overset{4}{\cancel{5}}\ \overset{9}{\cancel{10}}\ \overset{12}{\cancel{2}} \\ 502 \\ -\ 273 \\ \hline 229 \end{array}$

6000 - 428

```
        2        70        500        5000
    ⌒         ⌒         ⌒          ⌒
←──┼──────────┼──────────┼──────────┼──────────┼──→
  428        430        500        1000       6000
```
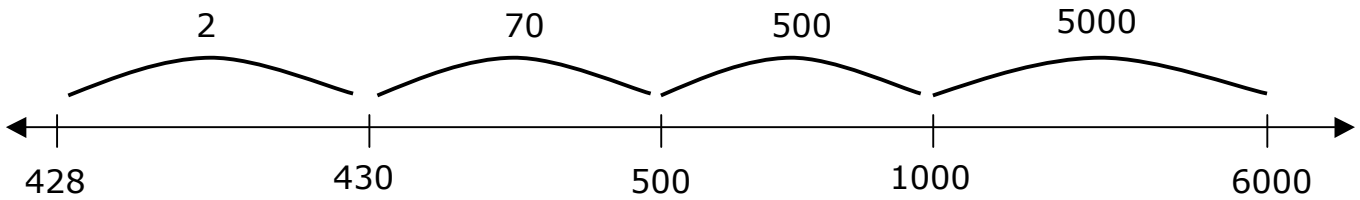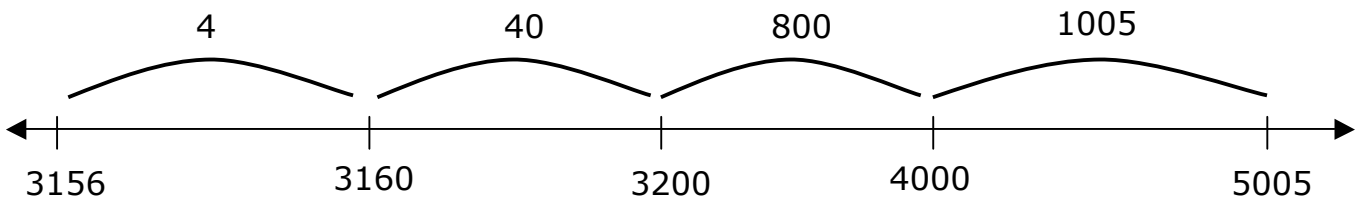
$$\begin{array}{r} 2 \\ 70 \\ 500 \\ +\ 5000 \\ \hline 5572 \end{array}$$

$\begin{array}{r}6000 \\ -\ 428\end{array}$ $=$	$\begin{array}{r}5999+1 \\ -\ \ 428 \\ \hline =\ 5571+1 \\ =\ 5572\end{array}$	$$\begin{array}{r}5\ \overset{9}{1\!\!\!/0}\ \overset{9}{1\!\!\!/0}\ 10 \\ 6\!\!\!/0\!\!\!/0\!\!\!/0 \\ -\ 428 \\ \hline 5572\end{array}$$

5005 − 3156

```
        4         40        800       1005
    ⌒         ⌒         ⌒          ⌒
←──┼──────────┼──────────┼──────────┼──────────┼──→
 3156       3160       3200       4000       5005
```
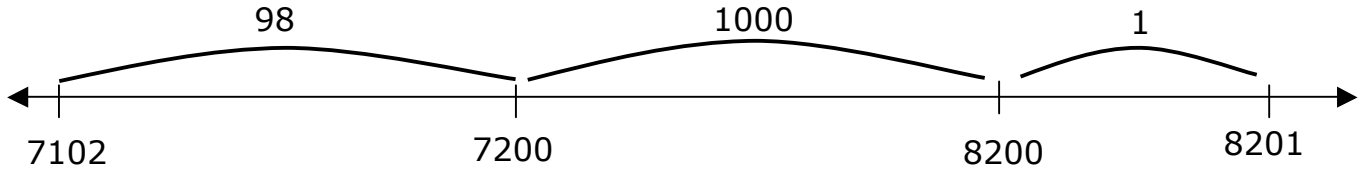
$$\begin{array}{r} 4 \\ 40 \\ 800 \\ +\ 1005 \\ \hline 1849 \end{array}$$

$\begin{array}{r}5005 \\ -\ 3156\end{array}$ $=$	$\begin{array}{r}4999+1+5 \\ -\ 3156 \\ \hline =\ 1843+1+5 \\ =\ 1849\end{array}$	$$\begin{array}{r}4\ \overset{9}{1\!\!\!/0}\ \overset{9}{1\!\!\!/0}\ 15 \\ 5\!\!\!/0\!\!\!/0\!\!\!/5 \\ -\ 3156 \\ \hline 1849\end{array}$$

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8201 – 7102

| 7102 | 7200 | 8200 | 8201 |

$$
\begin{array}{r}
98 \\
1000 \\
+\ \ 1 \\
\hline
1099
\end{array}
$$

$\begin{array}{r} 8201 \\ -\ 7102 \\ \hline \end{array}$ $=$	$\begin{array}{rl} & 7999+1+201 \\ - & 7102 \\ \hline = & 897+1+201 \\ = & 898+1+200 \\ = & 1098+1 \\ = & 1099 \end{array}$	$\begin{array}{r} \overset{9}{1\ \ \overset{10}{1}0\ \ 11} \\ 8201 \\ -\ 7102 \\ \hline 1099 \end{array}$

9030 – 4468

| 4468 | 4470 | 4500 | 5000 | 9000 | 9030 |
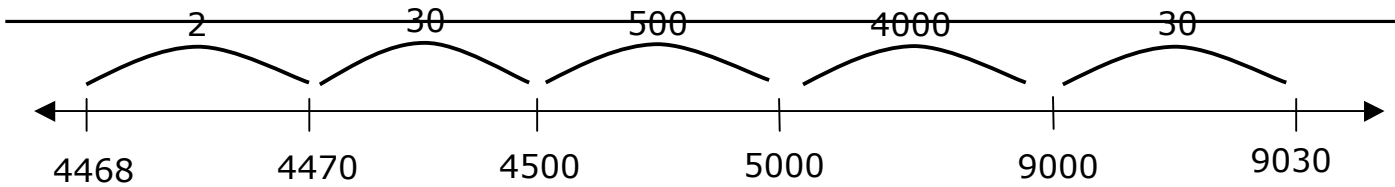
$$
\begin{array}{r}
2 \\
30 \\
500 \\
4000 \\
+\ \ 30 \\
\hline
4562
\end{array}
$$

$\begin{array}{r} 9030 \\ -\ 4468 \\ \hline \end{array}$ $=$	$\begin{array}{rl} & 8999+1+30 \\ - & 4468 \\ \hline = & 4531+1+30 \\ = & 4562 \end{array}$	$\begin{array}{r} \overset{9}{8}\ \overset{12}{10}\ \overset{10}{2} \\ 9030 \\ -\ 4468 \\ \hline 4562 \end{array}$

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