



*Uplifting Mathematics for All*

# *Exploding Dots™*

## HANDOUTS

### Experience 4: Subtraction

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## Exploding Dots

### Experience 4: Subtraction

Access videos of all *Exploding Dots* lessons at: <http://gdaymath.com/courses/exploding-dots/>

#### Handout A: Subtraction

We can now perform subtraction in a  $1 \leftarrow 10$  machine simply by adding antidots. (Some people prefer to call them tods.)

$$\begin{array}{r} 512 \\ -347 \\ \hline 2|-3|-5 \end{array} \quad \begin{array}{|c|c|c|} \hline \bullet\bullet\bullet \\ \bullet\bullet\bullet \\ \hline \circ\circ\circ \\ \circ\circ\circ \\ \hline \bullet \\ \circ\circ\circ \\ \hline \bullet\bullet \\ \circ\circ\circ\circ \\ \hline \end{array} = \begin{array}{|c|c|c|} \hline \bullet\bullet \\ \hline \circ\circ \\ \hline \circ\circ\circ \\ \hline \end{array} \begin{array}{c} 2 \\ -3 \\ -5 \end{array}$$

Unexplosions then show that this answer is the same as 165.

**Here is a question for you to try, if you like.**

Compute each of the following two ways: the dots-and-boxes way (and fixing the answer for society to read) and then with the traditional algorithm. The answers should be the same.

$$\begin{array}{r} 6328 \\ - 4469 \\ \hline \end{array} \quad \begin{array}{r} 78390231 \\ - 32495846 \\ \hline \end{array}$$

**Thinking question along the way:** As you fix up your answers for society, does it seem easier to unexplode from left to right, or from right to left?

**Additional question:** Do you think you could become just as speedy the dots-and-boxes way as you currently are with the traditional approach?

## Solutions to Handout A

$$6328 - 4469 = 2 \mid -1 \mid -4 \mid -1 = 1 \mid 9 \mid -4 \mid -1 = 1 \mid 8 \mid 6 \mid -1 = 1 \mid 8 \mid 5 \mid 9 = 1859$$

$$\begin{aligned} 78390231 - 32495846 &= 4 \mid 6 \mid -1 \mid 0 \mid -5 \mid -6 \mid -1 \mid -5 \\ &= 4 \mid 5 \mid 9 \mid 0 \mid -5 \mid -6 \mid -1 \mid -5 \\ &= 4 \mid 5 \mid 8 \mid 10 \mid -5 \mid -6 \mid -1 \mid -5 \\ &= 4 \mid 5 \mid 8 \mid 9 \mid 5 \mid -6 \mid -1 \mid -5 \\ &= 4 \mid 5 \mid 8 \mid 9 \mid 4 \mid 4 \mid -1 \mid -5 \\ &= 4 \mid 5 \mid 8 \mid 9 \mid 4 \mid 3 \mid 9 \mid -5 \\ &= 4 \mid 5 \mid 8 \mid 9 \mid 4 \mid 3 \mid 8 \mid 5 = 45894385 \end{aligned}$$

I personally find it much easier to do the unexplosions from left to right.

## *Exploding Dots*

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#### Handout B: *WILD EXPLORATIONS*

Here are some “big question” investigations you might want to explore, or just think about. Have fun!

#### *EXPLORATION 1: IS THERE ANOTHER WAY TO INTERPRET THE DOTS-AND-BOXES ANSWERS?*

When Sunil saw,

$$\begin{array}{r} 512 \\ -347 \\ \hline 2|-3|-5 \end{array}$$

he wrote on his paper the following lines:

$$\begin{array}{r} 200 \\ -30 \\ -5 \end{array}$$

He then said that the answer has to be 165.

- a) Can you explain what he is seeing and thinking?
- b) What would Sunil likely write on the page for  $7109 - 3384$ ?

#### *EXPLORATION 2: WHAT ABOUT NEGATIVE ANSWERS?*

How might you handle and interpret this subtraction problem?

$$\begin{array}{r} 148 \\ -677 \\ \hline \end{array}$$