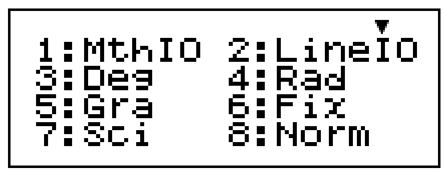
Middle Grades Activity:
Absolute Value and Distances on the Number Line, part 2

CALCULATORS: Casio *fx-300ES*

INTRODUCTION:
This activity further establishes in students' minds the idea that absolute value should be equated with the concept of *distance*.
The absolute value of a *sum* can always be treated as a difference:
$|a+b| = |a-(-b)|$
Multiplying an absolute value can be seen as multiplying a particular distance.

PROCEDURE:

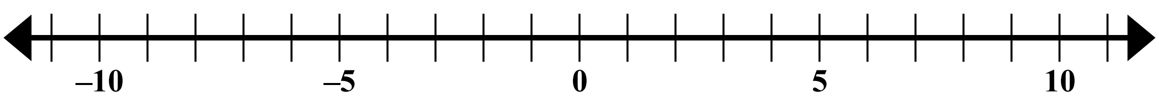
Turn the calculator **[ON]**.



Make sure the *fx*-300ES is set up correctly for this activity by pressing the following key sequences:

[SHIFT]-[SETUP] [1] to enter Math Input/Output mode;
[SHIFT]-[SETUP] [8] [1] to enter Normal Display 1.

Consider the following number line:



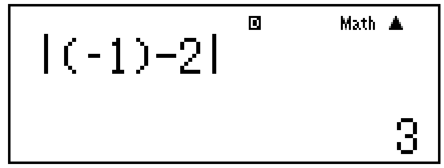
Plot the points P and Q on the number line, with coordinates P = –1, Q = 2.

<u>*Exercise 1.*</u> *Using methods learned in Part 1 of this Activity, write two different absolute value expressions that show the distance between P and Q.*

_________________________ _________________________

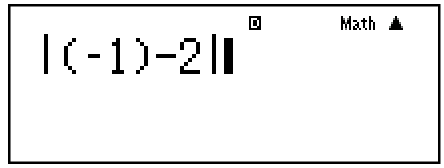
You can use your *fx-300ES* to show that these two expressions are the same:

Type **[Abs] [( ] [(-)] [1] [ )] [–] [2] [=]**.

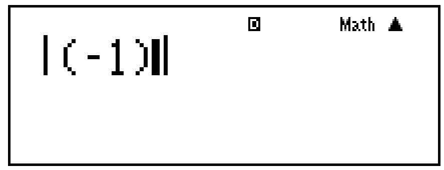


Instead of typing the second absolute value expression from scratch, you can use the Replay feature to save a few keystrokes:

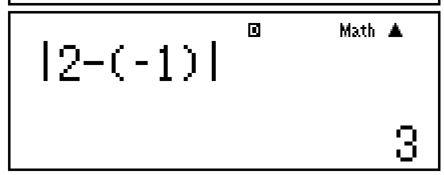
Press **[ ]** to place the cursor at the right edge of the previous expression.



Press **[ ]** again to move the cursor inside the absolute value bars, then press **[DEL]** twice.



Press **[ ]** four times, then type **[2] [–] [=].**



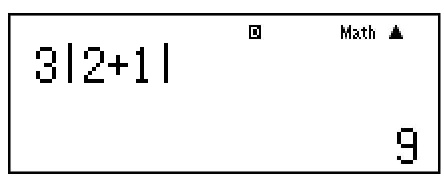
Since you are subtracting a negative number, you can express the difference $2-(-1)$ as the sum 2 + 1.

<u>Exercise 2.</u> Use the Replay feature to change the last expression entered to $|2+1|$.

The results of Exercise 2 show you that the absolute value of a *sum* is <u>also</u> describing a distance, since that sum can be written as a *difference*!

Now – suppose the distance between P and Q is tripled. This can be shown by the expression $3|2+1|$.

Type **[3] [Abs] [2] [+] [1]**.

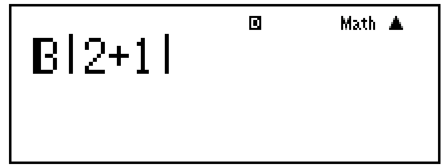


What exactly would need to happen to points P and Q for the distance between them to triple? Let's find out.

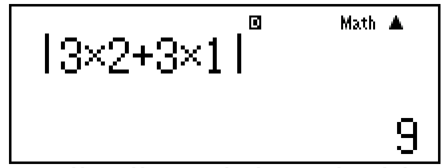
In an expression like $3(2+1)$, you can use the Distributive Property to multiply the 3 into both the 2 and the 1: $(3 \cdot 2 + 3 \cdot 1)$. Try something similar with the absolute value.

(You'll use the Replay feature again, but from the *left* side of the expression this time.)

Press **[ ]**.
(The symbol you see in the screenshot at the right is <u>not</u> a letter "B", but simply what the cursor will look like when flashing to the left of the "3".)



Press **[ ] [DEL]**, then **[ ] [3] [x]** and **[ ][ ] [3] [x]**.
Finally, press **[=]**.

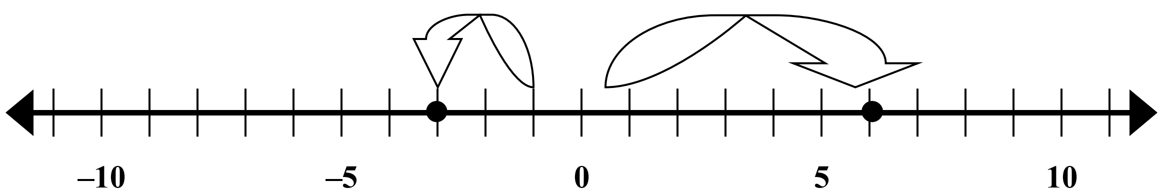


The tripled distance was preserved, even though you distributed the 3 inside the absolute value bars.

You can multiply 3 ´ 2 and 3 ´ 1 to make the expression $|6+3|$.

<u>Exercise 3.</u> Rewrite the expression $|6+3|$ *as a <u>difference</u>, then evaluate it using your calculator.*

So – by tripling the distance between points P and Q, we have expressed the distance between 6 and –3 on the number line. In other words, P is 3 three times farther from zero (–1 became –3) and Q is also 3 times farther from zero (2 became 6).



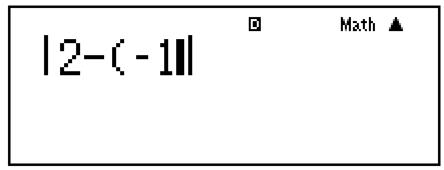
SOLUTIONS TO EXERCISES:

Exercise 1. Recall that $|a - b|$ shows the distance between *a* and *b*. Therefore, the distance between P and Q can be shown in these two ways:

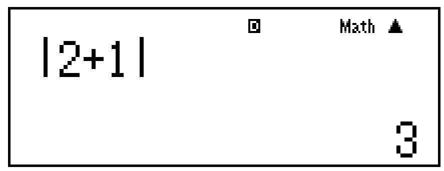
$$|(-1) - 2| \qquad \text{or} \qquad |2 - (-1)|$$

Exercise 2. One possible sequence of proper keystrokes is:

[ ][ ] [DEL]



[ ] [DEL] [DEL] [DEL]   [+]   [=]



Exercise 3. The expression can be written: $|6 - (-3)|$.

Type: **[Abs] [6] [–] [( ] [(-)] [3] [ )] [=]**.