

Operation Rules

ID: 13292

Time required
15 minutes

Activity Overview

This activity allows students to work independently to discover the rules for finding sums, differences, products, and quotients of real numbers. The dynamic screens give instant answers to problems, allowing students to constantly make and test conjectures by simply dragging points along a number line.

Topic: Properties of Real Numbers

- *Positive and negative real numbers*
- *Operations with real numbers*

Teacher Preparation and Notes

- *This activity is designed to be used in an Algebra 1 classroom. It can also be used in a Pre-Algebra classroom, or by any student learning the rules for operating with real numbers.*
- *This activity is intended to be mainly **student-led**, with breaks for the teacher to introduce concepts or bring the class together for a group discussion. Each student should have his or her own handheld.*
- **To download the student TI-Nspire document (.tns file) and student worksheet, go to education.ti.com/exchange and enter “13292” in the keyword search box.**

Associated Materials


- *OperationRules_Student.doc*
- *OperationRules.tns*

Suggested Related Activities

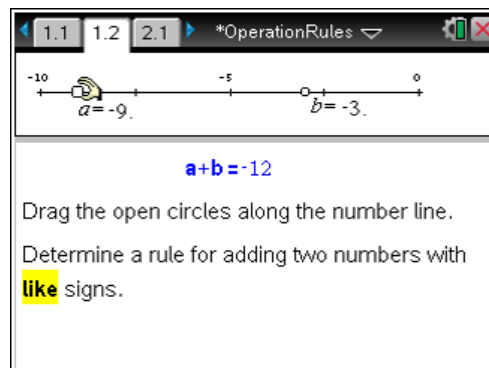
To download any activity listed, go to education.ti.com/exchange and enter the number in the keyword search box.

- *Closure Tables (TI-Nspire technology) — 8639*
- *Hot Air Balloon (TI-Nspire technology) — 8245*
- *One Step at a Time (TI-Nspire technology) — 8678*

Addition and Subtraction

Tech Tip: If students experience difficulty dragging a point, check to make sure that they have moved the cursor until it becomes a hand (☞) getting ready to grab the point. Also, be sure that the word *point* appears. Then press **ctrl**  to grab the point and close the hand (☞).

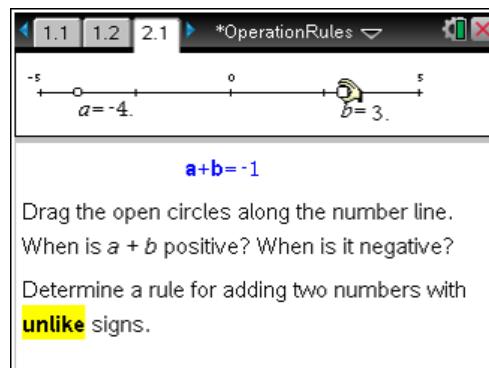
On page 1.2, instruct students to grab and drag each of the open circles and observe the sum. They should find that adding two negative numbers always results in a negative number—this can be combined with what they already know about the sum of two positive numbers by thinking: “positive + positive = positive” and “negative + negative = negative.”



$a + b = -12$

Drag the open circles along the number line.
Determine a rule for adding two numbers with **like** signs.

On page 2.1, students should again drag the open circles to seek to describe what the result will be, including whether it is positive or negative. This time, they will explore the sum of two numbers with unlike signs, and it is here that students may need guidance as to how to form the rules.



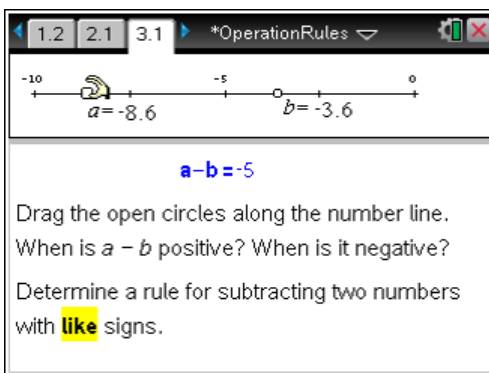
$a + b = -1$

Drag the open circles along the number line.
When is $a + b$ positive? When is it negative?
Determine a rule for adding two numbers with **unlike** signs.

(Note: In this diagram, a is always negative and b is always positive.)

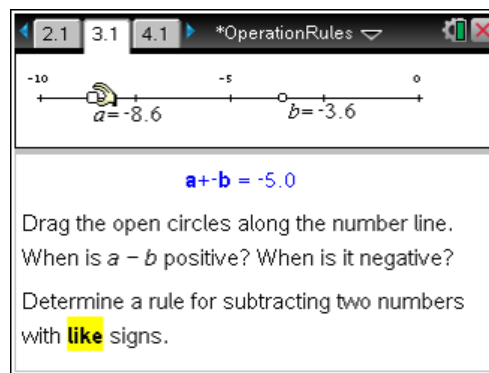
Students should work independently through pages 3.1 and 4.1. Walk around the room and assist students as needed. (Pages 3.1 and 4.1 are identical to pages 1.2 and 2.1, with the exception that they are used to explore subtraction instead of addition.)

Have a discussion about students’ findings. Show them how subtraction can be written as addition of the opposite (i.e., $a - b = a + (-b)$). Have them return to pages 3.1 rewrite the subtraction expressions in the math box as addition to see that the results do not change.



$a - b = -5$

Drag the open circles along the number line.
When is $a - b$ positive? When is it negative?
Determine a rule for subtracting two numbers with **like** signs.



$a + b = -5.0$

Drag the open circles along the number line.
When is $a - b$ positive? When is it negative?
Determine a rule for subtracting two numbers with **like** signs.

Possible observations/rules:

If a and b have like signs, add the absolute value of the addends and keep the common sign. If a and b have unlike signs, subtract the absolute values of the addends and keep the sign of the addend with the greater absolute value.

To subtract two numbers a and b , rewrite as addition and solve as described above:

$$a - b = a + (-b).$$

Multiplication and Division

In a manner similar to the Addition and Subtraction problems, have students work through pages 5.1 and 6.1 to explore the multiplication and division of numbers with like or unlike signs.

It is worth noting that the product of two positive numbers is positive. Use the slider to explore the product of two negatives then the product of numbers with unlike signs.

Discuss findings as a group, and make sure that students have recorded the sign rules correctly and described their conclusions in a way that is accurate.

The screenshot shows a TI-Nspire calculator window titled '*OperationRules'. At the top, there are tabs for '3.1', '4.1', and '5.1'. Below the tabs is a number line with tick marks at -10, -5, and 0. An open circle is placed at -8.6, labeled 'a = -8.6'. Another open circle is placed at -3, labeled 'b = -3'. Below the number line, three equations are displayed: $a \cdot b = 25.8$, $\frac{a}{b} = 2.9$, and $\frac{b}{a} = 0.3$. Below the equations, there is a text box that says: 'Drag the open circles along the number line. Determine a rule for multiplying or dividing two numbers with like signs.'

Possible observations/rules:

If a and b have the same sign, ab and $\frac{a}{b}$ are positive. If a and b have different signs, ab and $\frac{a}{b}$ are negative.

Multiplication can be represented as repeated addition or a pattern.

$$\text{For example, } 5 \cdot (-2) = (-2) + (-2) + (-2) + (-2) + (-2) = -10$$