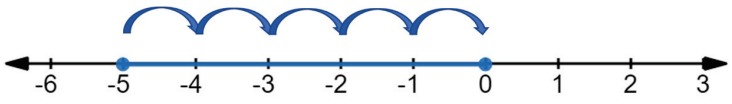
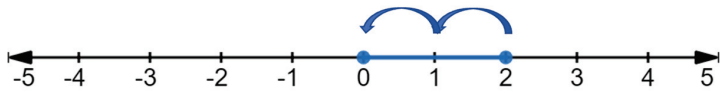
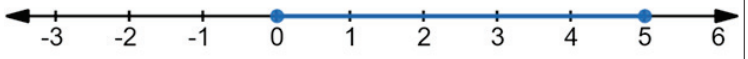
Quick Review 6

Absolute Value and Order of Operations

Model 1 Absolute Value

When a number is displayed between two vertical lines, this represents the absolute value operation. For example, |2| is read as "the absolute value of 2."

Absolute Value Example	Number Line Representation	Simplified Value
$\lvert -5 \rvert$		5
$\lvert 2 \rvert$		2
$\lvert 5 \rvert$		5
$\lvert -10 \rvert$		10
$\lvert 0 \rvert$		0

1. Consider the arrows displayed in first two examples of Model 1.

   a) The arrows lead to what plotted point/value?

   b) What in the "Absolute Value Example" column determines the starting point of the arrows?

   c) What is the relationship between the number of arrows and the simplified value?

2. Draw in the appropriate arrows for the third example, |5|. Why is the simplified value the same for |-5| and |5|?

3. Based on the number lines in Model 1, what do you think the meaning of absolute value is?

4. When given an absolute value, should the simplified value always be *greater than or equal to zero* or *less than or equal to zero*? Discuss as a team and explain why.

5. The general rule for absolute value is as follows

If a is a positive number, $|a| = a$; and, if a is a negative number, $|a| = -a$.

Discuss as a team and explain in words what this rule is saying.

6. Simplify each absolute value below.

a) $|-7|$

b) $|92|$

c) $|-11.7|$

d) $|1|$

Model 2 Distance on a Number Line

Example	Number Line Representation	Absolute Value	Simplified Value
Distance between −7 and 3		$\lvert -7-3\rvert$ or $\lvert 3-(-7)\rvert$	10
Distance between 3 and 12		$\lvert 3-12\rvert$ or $\lvert 12-3\rvert$	9
Distance between −9 and −2		$\lvert -9-(-2)\rvert$ or $\lvert -2-(-9)\rvert$	7

7. How can a number line be used to find the distance between two values?

8. To find the distance between -7 and 3,

   a) What two absolute values can be used to calculate the distance?

   b) What is different about the expressions inside the absolute values?

9. If asked to find "the distance between a and b", what two absolute value notations could be used?

10. Why does the order in which we subtract the two values not matter?

11. Calculate the distance between each pair of values without drawing number lines:

    a) 17 and 21

    b) -119 and 54

    c) -496 and -14

    d) 12 and -19

Model 3 Multi-Step Calculations with Real Numbers

Problem	Calculation	Simplification Steps
1	$3 + 2 \times 7 - 3^2$ $3 + 2 \times 7 - 9$ $3 + 14 - 9$ $17 - 9$ 8	1. Exponent 2. Multiply 3. Add 4. Subtract
2	$6(1 - 5) - 9 \div (-2 - 1)$ $6(-4) - 9 \div (-3)$ $-24 - 9 \div (-3)$ $-24 - (-3)$ -21	1. 2. 3. 4.
3	$\{3[-2 - 5 \div (-3 - 2) \times 4]\}$ $\{3[-2 - 5 \div (-5) \times 4]\}$ $\{3[-2 - (-1) \times 4]\}$ $\{3[-2 - (-4)]\}$ $\{3[2]\}$ 6	1. Simplify inner-most parentheses 2. Simplify inside brackets a. Divide b. Multiply c. Subtract 3. Multiply
4	$\dfrac{[(12 \div 4 \times 5) \div 3] + 2}{3^2 - 2}$ $\dfrac{[(3 \times 5) \div 3] + 2}{3^2 - 2}$ $\dfrac{[15 \div 3] + 2}{3^2 - 2}$ $\dfrac{5 + 2}{3^2 - 2}$ $\dfrac{7}{3^2 - 2}$ $\dfrac{7}{9 - 2}$ $\dfrac{7}{7}$ 1	1. Simplify Numerator a. Inside parentheses: i. ii. b. Divide c. Add 2. Simplify Denominator a. ii. 3. Divide

12. True or False: In Problem 1, the operations are performed from left to right. Explain.

13. Use Problem 3 from Model 3 to answer the following questions:

a) What is done in step 1 to simplify inside the inner-most parentheses?

b) In what order are the operations done to simplify inside of the brackets?

14. Fill in the missing steps for Problems 2 & 4 in Model 3 based on the steps performed on the given problem.

15. Is multiplication always performed before division?

16. Based on the problems in Model 3, put the following operations in the correct order.

Multiplication & Division (left to right)
Exponents
Groupings including ( ),[ ],{ } (inside to outside)
Addition & Subtraction (left to right)

17. Another form of "grouping" is the large fraction bar, separating the numerator and denominator. What problem in Model 3 demonstrates this form of grouping?

18. In Problem 3 of Model 3, why is the division $5 \div -5$ performed before the multiplication of 4?

19. Two students were given an expression and asked to simplify. Below is their work. Who is correct and why?

Lowell's Work	**Avery's Work**
$15 \div [2(1 - 5 \times 2) + 8] \times 2$	$15 \div [2(1 - 5 \times 2) + 8] \times 2$
$15 \div [2(1 - 10) + 8] \times 2$	$15 \div [2(1 - 10) + 8] \times 2$
$15 \div [2(-9) + 8] \times 2$	$15 \div [2(-9) + 8] \times 2$
$15 \div [-18 + 8] \times 2$	$15 \div [-18 + 8] \times 2$
$15 \div [-10] \times 2$	$15 \div [-10] \times 2$
$15 \div [-20]$	$-\frac{3}{2} \times 2$
$-\frac{3}{4}$	-3

20. Simplify each expression by following the Order of Operations from Question 16. Check your work: One of the expressions should simplify to zero and one should result in a negative number.

a) $-2[3 + 7(6 - 4)^4 - 20]$

b) $\dfrac{10 \div (9 - 7) + 3 \cdot 4}{2^3 + 3^2} - 1$

Exercises

1. Simplify each absolute value.

   a) $|-12|$

   b) $|37|$

   c) $|-90|$

   d) $|0|$

   e) $-|6|$

   f) $|16|$

   g) $-|-8|$

2. Find the distance between each pair of numbers.

   a) 14 and 79

   b) 0 and 13

   c) -20 and -50

   d) -73 and -84

   e) -19 and 80

   f) 58 and -342

3. Simplify each expression. Write your answers as integers or fractions.

   a) $8 \times (7^2 - 5)$

   b) $(7 + 5) \times (6 - 9)$

   c) $(17 - (3 + 5)) \times 3$

   d) $(2^2 \div 1) \times (9^2 + 5) \times 9$

   e) $8 - (4^3 \div 8 \div 2 \times 2)$

   f) $(18 \div 3 + 28 \div 4 + 2 \times 4) \div 3$

   g) $9^3 \times \frac{5}{3} \div 3 \times 4^2$

h) $(8 + 5^2) \times ((9 - 7)^2 \div 2)$

i) $\dfrac{10 \times (6 + 4)}{(2^3 - 7)^2}$

j) $(-3 \times (10 + (-7)))^2 \div 3 - (-9)^2$

k) Challenge Problem: $\left(\dfrac{1}{6} - \dfrac{3}{4} + \left(-\dfrac{1}{4}\right)\right)^2 \times \left(\dfrac{4}{9} \div \dfrac{1}{9} + \dfrac{5}{8}\right)$