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Support Understanding of Algebra by Using Multiple Strategies to Solve Problems

Learning About Algebra at Home: Evidence-Based Tips for Parents and Caregivers

Parents and caregivers can use these activities to help youth learn to solve algebra problems using different **strategies**. Knowing different strategies for solving algebra problems may help your child approach algebra problems with confidence. Your child could apply the most appropriate strategy for a particular problem or could try a different strategy if getting the solution is still challenging. These tips for parents and caregivers are based on the *Teaching Strategies for Improving Algebra Knowledge in Middle and High School Students Practice Guide*.

Use the following activities to encourage your child to try multiple strategies and understand the advantages of doing so.

- After your child has solved a problem, ask your child to think of another strategy to solve the problem.

- Ask your child to think about the advantages and disadvantages of different strategies for solving problems. Recognize that some strategies will work better for a particular problem than others.

> **Strategies** are different ways to solve the same problem. Each strategy might use different solution steps or apply different mathematical rules or formulas.

The example activities are most appropriate for youth who are already familiar with solving linear equations, most often in grades 7-9. They can also be adapted for youth who have less experience with these concepts.

Example activity: solving algebra problems multiple ways

On the next page, we present three problems, each solved using two different strategies. Begin each problem by asking your child, "How would you solve this problem?"

After your child has finished solving the problem using one strategy, ask, "Can you think of another way to solve this problem?"

Your child may identify one of the strategies below or propose another approach.

Problem 1: Calculating a restaurant bill with tip

Our restaurant bill, including tax but before tip, was $16.00. If we wanted to leave exactly a 15% tip, how much money should we leave in total?

Strategy 1: Multiply

A tip of 15% means multiplying the bill's total by 1.15:

$16.00 x 1.15 = $18.40

You could also multiply $16.00 by 0.15 to find the amount of the tip alone, which is $2.40. To find the amount of money to leave in total, you would add the original bill of $16.00 and the tip of $2.40.

Strategy 2: Break up the tip

A tip of 15% can be thought of as a tip of 10% and a tip of 5% added together.

10% of $16.00 is $1.60.

5% is half of 10%, so we can calculate 5% of $16.00 as half of $1.60, which is $0.80.

Adding together the two parts of the tip gives $1.60 + $0.80 = $2.40

So the total bill with tip would be $16.00 + $2.40, or $18.40.

*The total bill with tip would be $18.40 using either strategy.*

Problem 2: Extending a garden plot

You have a rectangular garden plot that is 2 feet long and 3 feet wide. You can plant one flower per square foot, so you currently can plant 6 flowers. How much longer than 2 feet would you need to extend your garden plot so that it is large enough to plant 15 flowers?

The total area for a rectangle is calculated as the length of one side multiplied by the length of the side next to it—length multiplied by the width.

x = the length in feet of the extension.

Original garden plot

Garden plot extension

Your child may wish to draw a picture of this problem, such as the one to the right, to help with the strategies below.
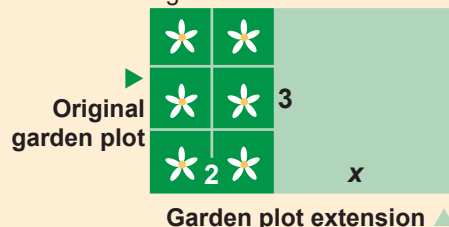
Strategy 1: Use the distributive property

The area for the extended garden plot is $3(2 + x)$, where x represents the extension to the length.

$3(2 + x) = 15$

You can use the **distributive property** in a strategy to solve this equation.

$3(2 + x) = 15$

$6 + 3x$
$3x = 9$
$x = 3$

So we need to extend the length of the plot by 3 feet to a total of 5 feet.

Strategy 2: Divide both sides by 3

Instead of using the distributive property, you can divide both sides of the equation by 3.

$3(2 + x) = 15$

$$\frac{3(2 + x)}{3} = \frac{15}{3}$$

$2 + x = 5$

So $x = 3$ feet.

The plot needs to be extended by 3 feet to allow enough space for 15 flowers. This answer is the same using either strategy.

Distributive property

Use the **distributive property** to evaluate multiplication problems that take the form $a(b + c)$. That means you can write the expression $a(b + c)$ as the sum of two products: $ab + ac$, where ab means a is multiplied by b and ac means a is multiplied by c. Take this example:

$3(y + 6) = (3 \times y) + (3 \times 6)$
$= 3y + 18$

In this example, using the distributive property means multiplying each of the terms inside the parentheses by 3.

Problem 3: Evaluating an algebraic expression

Evaluate $2a + 4b - 7a + 2b - 8a$ if $a = 1$ and $b = 7$.

Strategy 1: Substitute values	Strategy 2: Combine like terms
This problem tells you the values of a and b. You can evaluate the problem by substituting the values of a and b into the expression and finding the total value of the expression. Substituting values means to replace a and b with their values everywhere they appear in the expression. $2a + 4b - 7a + 2b - 8a$ $2(1) + 4(7) - 7(1) + 2(7) - 8(1)$ $2 + 28 - 7 + 14 - 8$ 29	You can evaluate the problem by **combining like terms** to simplify the expression before substituting for the values of a and b. $2a + 4b - 7a + 2b - 8a$ Combine the a terms: $2a - 7a - 8a = \text{-}13a$ Combine the b terms: $4b + 2b = 6b$ $\text{-}13a + 6b$ $\text{-}13(1) + 6(7)$ 29

The expression evaluates to 29 using the given values of a and b. The answer is the same using either strategy.

Combining like terms

Combining like terms is a way to simplify an expression. **Like terms** have the same **variable**, but their **coefficients** may be different. A variable is a quantity with an unknown value, often written as x or y in algebraic expressions. A coefficient is a numerical quantity placed before a variable. For example, in the term $4x$, 4 is the coefficient, and x is the variable. This term is equal to 4 multiplied by x. $4x$ and $\text{-}2x$ are like terms because they have the same variable—in this case, x. To combine like terms, you add the coefficients on the like terms.

Share with your child another benefit to using multiple strategies: "When you use different strategies from the one you first used, you are able to check your work!" Ask your child: "Can you check your work using another strategy to solve the problem? Did you identify any errors in your work when you used the second strategy?"

If your child uses a different strategy from what is in the table, praise their creativity: "It is great to be creative when you are solving problems!"

Questions to ask your child about their strategies as they solve algebra problems

As in the examples above, most algebra problems can be solved in numerous ways, but some strategies might be easier or work better for some problems. You can discuss with your child why different strategies work well or do not work well for each problem. Not all strategies are appropriate for all problems; different strategies have advantages and disadvantages, depending on the problem.

You can encourage your child to talk about their reasoning for how they chose to solve a problem:

- What do you know about solving these types of problems?
- What was the problem asking?
- How did you get your answer? How do you know it is correct?
- What was most difficult about this problem? Did you run into any challenges? If so, what did you do to overcome them?

The What Works Clearinghouse (WWC) and WWC Practice Guides

The What Works Clearinghouse, funded by the U.S. Department of Education, reviews existing research on programs, products, practices, and policies in education. Our goal is to provide educators with the information they need to make evidence-based decisions. Bringing together rigorous research practice and content expertise, the WWC creates Practice Guides to equip educators with the best available evidence and expertise on current challenges in education. These tips for parents and caregivers are based on the first action step, "Teach students to recognize and generate strategies for solving problems," within Recommendation 3, "Teach students to intentionally choose from alternative algebraic strategies when solving problems," from the *Teaching Strategies for Improving Algebra Knowledge in Middle and High School Students* Practice Guide. To learn more about the research evidence and for additional recommendations and action steps for learning about algebra at home, read the full practice guide: https://ies.ed.gov/ncee/wwc/PracticeGuide/20.