Advanced 2 Section 5.3: Solving Systems of Linear Equations by Elimination
Essential Question: How can you use elimination to solve a system of linear equations?

Objective: Students will solve systems of linear equations by elimination. **Previous Learning:** Students should know how to solve linear equations and evaluate expressions at a specified value of the variable. **Materials for Motivate in Teaching Edition:** none **Materials for Laurie's Notes in Teaching Edition:** none **Materials for Activities/Examples in Pupil Edition:** graphing calculator ***Pacing:** 45 minutes ****The suggested Activities and Examples below provide students an opportunity to develop a deep understanding of the concepts within the time allotted in the Pacing Guide. Additional Activities and Examples are available in the textbook if time permits.***	**CC State Standards** 8.EE.8b, 8.EE.8c	**CC Mathematical Practice Focus** MP1, MP3a, MP7

1. INTRODUCTION (10 minutes)

Warm Up

Have students answer *Start Thinking!* and/or *Warm Up* questions. Review the answers as a class.
Review previously assigned homework, if necessary.

2. ACTIVITY 1 (8 minutes)

Using Elimination to Solve a System

This activity solves a system of linear equations by using two methods.

- Students may not understand what it means to add or subtract equations. Tell them to think about the balance scales—they added the left sides of the scales and the right sides of the scales.
- As you walk around, you may need to remind students what it means to solve a system.
- After students find the value of one variable, ask, "How can you find the value of the other variable?"
- Discuss the solutions found using each method (addition and subtraction).
- **Ask the question "Can you eliminate one variable by adding the equations for any system of two linear equations? Explain."**
- Discuss how elimination compares to the substitution method. With elimination, you add or subtract equations to eliminate a variable. With substitution, you write an equation in one variable by substituting an expression for the other variable. In both methods, you solve the resulting equation for one variable and use its value to find the other variable.

3. ACTIVITY 2 (7 minutes)

Using Elimination to Solve a System

This activity creates a system of linear equations that has a particular ordered pair as its solution.

- **Ask the question "What property did you use?"**
- When students finish, discuss the process and the solutions.

Focus on Mathematical Practice 7

In parts (b) and (c), students may first think of properties such as the Commutative and Associative Properties. Refer to the first balance scale and ask, "If you double the number of cubes and balls on one side, and the weight on the other, will the scale balance?" "What will each side weigh?"

4. Key Idea & EXAMPLE 2 (10 minutes)

Solving a System of Linear Equations by Elimination

This Key Idea states the steps in solving a system of linear equations by elimination.

- Discuss the steps for solving a system of linear equations by elimination. Students often find the steps very wordy, but the process is fairly simple and straightforward.
- As you work through each example, refer back to the steps listed.

This example solves a system of linear equations by elimination.

- Write the system of equations.
- Ask the question "What do you notice about this system?"
- Ask the question "Can you think of a way to rewrite the equations so that either the x-terms or the y-terms have coefficients that are the same or opposite?"
- Ask the question "If you wanted to eliminate the x-term, what could you do?"
- Discuss the two options: Multiplying the second equation by −3 and adding or multiplying by 3 and subtracting.
- First work through the problem using one approach. Then show how the other approach gives the same result in Step 2.
- Although both approaches give you the same solution, sometimes fewer computation errors occur when equations are added rather than subtracted. Some students prefer adding equations.
- **Common Error:** When multiplying through by a constant, be sure that students multiply *every* term by the constant. It helps to use color: $(3)(-2x - 4y) = 14(3)$. Remind students that they are using the Distributive Property.
- Before students try the problems on their own, ask, "What if this system had been written this way?"

  $5y - 6x = 25$
  $2x - 4y = 14$

- **Have students work independently to answer On Your Own Questions 1 and 3–6. Have students check with their neighbors as they work through the problems. Conclude by projecting the Key Idea.**

5. EXAMPLE 3 (10 minutes)

Real-Life Application

This example solves a system of linear equations by elimination to find the cost of each daylily.

- Ask a volunteer to read and summarize the problem: Two people bought different numbers of two types of flowers and paid different amounts.
- Although the problem is to find the cost per daylily, you need a second variable for the cost per hosta.
- Discuss the verbal model used to generate each equation.
- Ask the question "What does Equation 1 represent?"
- Ask the question "What does Equation 2 represent?"
- Ask the question "What do you notice about this system of equations that is different than the first two examples?"
- Students should recognize that 24 is the least common multiple of 8 and 3.
- Work through the problem as shown.
- Discuss alternative approaches to this problem.
- Multiply Equation 2 by $\frac{8}{3}$ and subtract to eliminate the *x*-terms.
- Multiply Equation 1 by 4 and Equation 2 by 5, and subtract to eliminate the *y*-terms.
- **Extension:** Determine the cost of each hosta plant.
- **Have students work independently to answer On Your Own Question 7. Have students check with their neighbors as they work through the problems.**

6. ASSESS (5 minutes)

Summary (from the *Lesson* section of the Pupil Edition)

Discuss the Summary box.

Summary

Methods for Solving Systems of Linear Equations

Method	When to Use
Graphing *(Lesson 5.1)*	To estimate solutions
Substitution *(Lesson 5.2)*	When one of the variables in one of the equations has a coefficient of 1 or −1
Elimination *(Lesson 5.3)*	When at least 1 pair of like terms has the same or opposite coefficients
Elimination (Multiply First) *(Lesson 5.3)*	When one of the variables cannot be eliminated by adding or subtracting the equations

What is Your Answer? (from the *Activity* section of the Pupil Edition)

Have students answer In Questions 4–6. Discuss the answers to these questions as a class. The reasoning involved in these questions will help students answer the Closure question below.

Closure (as time allows) (from the *Lesson* section of the Teaching Edition)

Write an example of a system for each condition relative to the solution by elimination.

- Adding or subtracting equations will eliminate one of the variables.
- You need to multiply one of the equations by an integer before you add or subtract.
- You need to multiply both of the equations by an integer (or one equation by a fraction) before you add or subtract.

Assignment:

- **1–6, 10, 12, 13, 14–26 even, 27–37**

Activity 5.3 **Start Thinking!**
For use before Activity 5.3

Consider the following equations: $3 + 7 = 10$

$2 + 4 = 6$

Add the equations.

$$\begin{array}{r} 3 + 7 = 10 \\ 2 + 4 = 6 \\ \hline 5 + 11 = 16 \end{array}$$

Perform the operation on the given equations.

1. Subtract the second equation from the first.
2. Multiply both sides of the first equation by 2 and add it to the second equation.

Are the resulting equations true?

How can you use this method to solve the following system?

$$x + y = 10$$

$$x - y = 4$$

Activity 5.3 **Warm Up**
For use before Activity 5.3

Solve the equation.

1. $6y = 90$

2. $-17x = 102$

3. $9x = -144$

4. $-11y = -209$

5. $4x + 20 = 4$

6. $-2y + 4 = -10$

Learning Goal

I will solve systems of linear equations by elimination.

Key Idea

Solving a System of Linear Equations by Elimination

Step 1: Multiply, if necessary, one or both equations by a constant so at least 1 pair of like terms has the same or opposite coefficients.

Step 2: Add or subtract the equations to eliminate one of the variables.

Step 3: Solve the resulting equation for the remaining variable.

Step 4: Substitute the value from Step 3 into one of the original equations and solve.