Systems of Linear Equations with the System Solver

In these activities, you explore the steps involved in solving systems of linear equations. You'll make observations about the effects of those operations on the solution sets of the systems. In Part 1, you'll solve three systems using pen, paper, calculator, etc. In Part 2, you'll solve the same systems and two others using an interactive tool called the System Solver, which you can find online at: http://seeingmath.concord.org/resources_files/SystemSolver.html.

Note: Discuss your ideas with your group. Be sure to clearly write each of your steps, describe your thinking about patterns you notice, and explain your reasoning in writing. Attach graphs and any additional work papers you use.

PART 1: WORKING WITH PEN AND PAPER

Jackie, Maya, and Shane used different methods to solve the systems of linear equations below. Their first steps are shown. Complete their solutions *without* the System Solver, paying close attention to each step in the process. For each challenge, use the table to document:

Steps: Describe, in order, the operation(s) you performed in each step of your solution. For example:

- Substituted $4 + x$ for y in the first equation
- Added 4 to both sides

Predictions: For each step, make these predictions:

If you are operating on only one of the equations:

- **Slope**: Will the slope of your new equation differ from the slope of the equation you're operating on?
- **y-intercept**: Will the y-intercept of your new equation differ from the y-intercept of the equation you're operating on?
- **Graph**: Will the graph of your new equation differ from the graph of the equation you're operating on?

If you are combining two equations:

- **Intersection point**: Will your new equation intersect the original system at a different point than the intersection point of the original system?
- **Graph**: Will the graph of your new equation differ from the graph of either of the equations in the original system?

Challenge A: Jackie's Method

In the system below, Jackie first re-wrote equation EQ 2 to generate EQ 3. Then she substituted the value of y from EQ 3 into EQ 1 to get EQ 4.

Complete Jackie's solution. Remember to record each step and your predictions as explained above.

$$\begin{cases} 10x - y = 32 & [\text{EQ } 1] \\ y - x = 4 & [\text{EQ } 2] \end{cases}$$

$$\begin{cases} 10x - y = 32 & [\text{EQ } 1] \\ y = 4 + x & [\text{EQ } 3] \end{cases}$$

$$\begin{cases} 10x - (4 + x) = 32 & [\text{EQ } 4] \\ y = 4 + x & [\text{EQ } 3] \end{cases}$$

Note Use as few or as many rows as you need. Use the back if you need additional space.

Steps	Predictions

Challenge B: Maya's Method

In the system below, Maya multiplied EQ 2 by −4 to get EQ 3. She then added EQ 3 to EQ 1 to get EQ 4.

Complete Maya's solution. Explain each step in solving the system, and remember to record your predictions.

$$\begin{cases} 2x + 4y = -28 & \text{[EQ 1]} \\ 5x + y = 2 & \text{[EQ 2]} \end{cases}$$

$$\begin{cases} 2x + 4y = -28 & \text{[EQ 1]} \\ -20x - \_\_\_ = \_\_\_ & \text{[EQ 3]} \end{cases}$$

$$\begin{cases} \_\_\_\_\_ & \text{[EQ 4]} \\ -20x - \_\_\_ = \_\_\_ & \text{[EQ 3]} \end{cases}$$

Note Use as few or as many rows as you need. Use the back if you need additional space.

Steps	Predictions

Challenge C: Shane's Method

Shane began solving this system by combining like terms in EQ 1 and EQ 2 to get a set of new equations (EQ 3 and EQ 4). He wasn't sure at first whether to use substitution or elimination. He decided to multiply his new equations by constants, EQ 3 by 3, and EQ 4 by −2 to get EQ 5 and EQ 6.

Complete Shane's solution. Record each step and your predictions.

$$\begin{cases} 2x + 2y + 2 = 5x + 4 & [\text{EQ } 1] \\ 5y - 1 = 2y - 5x & [\text{EQ } 2] \end{cases}$$

$$\begin{cases} 2y = 3x + 2 & [\text{EQ } 3] \\ 3y = -5x + 1 & [\text{EQ } 4] \end{cases}$$

$$\begin{cases} 6y = 9x + 6 & [\text{EQ } 5] \\ -6y = 10x - 2 & [\text{EQ } 6] \end{cases}$$

Note Use as few or as many rows as you need. Use the back if you need additional space.

Steps	Predictions

PART 2: USING THE SYSTEM SOLVER

Now you're going to use an online interactive tool called the System Solver to solve the previous three challenges (A-C) and two new ones (D and E). The System Solver let's you test your predictions from Challenges A-C by letting you see the effects of symbolic operations on:

- the table of values that make an equation true
- the graphic representations of the equations.

If you haven't yet familiarized yourself with the System Solver, either with assigned Warm-Up activities or on your own, please do that now. When you're satisfied that you understand how the System Solver operates, continue with the challenges below.

Challenges A-C Revisited

Open the System Solver and repeat Challenges A-C above. Throughout your exploration:

- Record your observations and make generalizations based on what you notice.
- Revisit the observations you made in Challenges A-C. Were your predictions correct?

Challenge D: A Closer Look at Solutions

Solve the system below using the System Solver.

$$\begin{cases} -4x + y = -2 \\ -2x + \frac{1}{2}y = 3 \end{cases}$$

How does the System Solver help you to make sense of the solution?

Challenge E: A Closer Look at Solutions

Solve the system below using the System Solver.

$$\begin{cases} -12x + 3y = 18 \\ y - 4x = 6 \end{cases}$$

How does the System Solver help you to make sense of the solution?