# Solving Systems by Graphing (6-1)

*Grade Level and Content*

8th Grade Algebra

*Big Idea*

Students first review the vocabulary that they were introduced to in the previous lesson. Students practice identifying solutions to systems of linear equations by plugging values into equations and by reading graphs. Students also practice graphing systems of linear equations to find the solutions. Finally, students explore a real-life scenario where solving linear equations helps in decision making.

*Objectives*

Students will be able to …

1. Correctly identify solutions of systems of linear equations in two variables 8 out of 10 times.
2. Correctly solve systems of linear equations in two variables by graphing 8 out of 10 times.

*PA State Standards*

**Anchor Descriptor - A1.1.2.2: Write, solve and/or graph systems of linear equations using various methods.**

**A1.1.2.2.1:** Write and/or solve a system of linear equations (including problem situations) using graphing, substitution and/or elimination (limit systems to 2 linear equations).

**A1.1.2.2.2:** Interpret solutions to problems in the context of the problem situation (systems of 2 linear equations only).

*Rationale for Students*

Solving equations first by graphing will help students to see what is happening when two equations share a solution. This will then give meaning to the other techniques for solving systems that students will learn in the next two lessons. All of this will improve retention of the material.

*Materials*

- 1 promethean board with computer
- 22 copies: 6-1 Practice C
- 22 sheets: graph paper
- Graphics calculators

*Adaptations for Special Needs*

This lesson engages students in a hands-on and visual way so they can see what the solution to a system of linear equations means. All students benefit from this approach, however, ST13 has a specific need for hands-on learning.

*Technology*

The promethean board will be used to present the lesson and enables the teacher and the students to work out solutions together. Students will each have access to a calculator to work through while one student is at the board. Students have access to online tutorials for each section so they can review concepts and have guided practice at home. All assignments will be posted on the class website so students who miss class won't fall behind.

## Anticipatory Set — 5 minutes, 5 minutes

Check vocabulary homework.

- Write each equation in slope-intercept form: $3x - y = 5$ ($y = 3x - 5$); $y + x = 2$ ($y = -x + 2$).
- Graph each linear equation by hand.
- Is (2, 1) a solution to either equation?

Are there any questions on how to convert an equation to slope-intercept form? On how to graph using the slope-intercept form?

Choose a student who has correctly written the first equation to graph it at the board.

Choose a student who has correctly written the second equation to graph it at the board.

*Write general slope-intercept equation if needed.*

1. **What is the slope of a line?** *(rise over run – rise is how many steps up or down and run is how many right or left)*
2. **What is the slope of the equation y = 3x – 5?**
3. **What does 3 mean as the slope?** *(3 is the rise and 1 is the run; go up 3, go right 1; for every 3 steps up, go 1 step right)*
4. **What is the y-intercept?** *(-5)*
5. **What does -5 mean as the y-intercept?** *(the line crosses the y-axis at -5)*

**Is (2, 1) a solution to either equation?** *(y = 3x – 5)*

**How do you check if an ordered pair is a solution to an equation?** *(Plug the x- and y-values into the equations to see if they make them true)*

1. **What is the slope of the equation y = -x + 2?**
2. **What does -1 mean as the slope?** *(-1 is the rise and 2 is the run; go down 1, go right 2; for every 1 step down, go 2 steps right)*
3. **What is the y-intercept?** *(2)*
4. **What does 2 mean as the y-intercept?** *(the line crosses the y-axis at 2)*
5. **What is the y-value when x = 2 for the equation y = -x + 2?** *(y = 0)*

## Procedure — 35 minutes, 40 minutes

Interactive Presentation — 15 minutes, 20 minutes

*Pass out graph paper*

**Yesterday you discovered the concept behind finding a solution to a group, or system, of equations. Today we are going to look at this idea a little more and practice solving systems by graphing.**

**Here are our definitions for today.** Choose a student to read.

**You are familiar with checking if an ordered pair is a solution to one equation. How do you think you check if an ordered pair is a solution to a system?** *(check both equations)*

**Take a minute to work on example 1.** Choose a student work it at the board and explain.

- ❖ **What did you do to check if the ordered pair was a solution to the system?**

**Example 2.** Choose a student to work at the board.

**The ordered pair does not make the first equation true.**

- **Do we have to check the second equation?** *(No)*

**Now let's find the solution by looking at a graph.**

**Example 3.** Choose a student to write the ordered pair on the board and explain.

- **What makes (2, 2) a solution to the system graphed here?**

**You are also familiar with graphing equations to find the solutions. Based on what we did yesterday, how will looking at a graph tell you what the solution is?** *(the point of intersection is the solution)*

**Here is our first example. Use graph paper to solve this system.** Choose a student work it at the board and explain.

**Example 4.** Choose a student to work it at the board and explain.

- **Explain what you did step by step.**
- **Verify that (3, -3) is the solution to the system.** *(plug values into each equation)*
- **What about the point (3, -3) makes it the solution to the system?** *(it makes both equations true)*

**Example 5.** Choose a student to work it at the board and explain.

- **Explain what you did step by step.**
- **Verify that (1, -1) is the solution to the system.** *(plug values into each equation)*
- **What about the point (1, -1) makes it the solution to the system?***(it makes both equations true)*

Problem Solving 15 minutes, 35 minutes

*Students will work on this problem in parts. The teacher will circulate to assess student progress and choose a student to work through each part at the board before moving on.*

**Number 18 on page 386**

The Warrior baseball team is selling hats as a fund-raiser. They contacted two companies. Hats Off charges a $20 design fee and $5 per hat. Top Stuff charges a $15 design fee and $6 per hat. For how many hats will the cost be the same for both companies? What is that cost?

**Understand the Problem**

**What information are we to find? There are two questions we need to answer.**

- For how many hats will the cost be the same for both companies?
- What is that cost?

Let's list important information.

| | | |
|---|---|---|
| Hat price | Hats Off: $5 | Top Stuff: $6 |
| Design fee | Hats Off: $20 | Top Stuff: $15 |

**Make a Plan**

**What can we do with our information?**

- Write a system of linear equations. One equation for each company to represent the cost of buying hats.

**What will be the answer to the first two questions?**

- the solution to a system of equations

Write an equation for each company's pricing.

| | Total Cost | Is | Price per hat | Times | Number of hats | plus | Design fee |
|---|---|---|---|---|---|---|---|
| **Hats Off** | y | = | 5 | · | x | + | 20 |
| **Top Stuff** | y | = | 6 | · | x | + | 15 |

**Solve**

We're going to graph these equations on the calculator but first let's consider the quadrant or quadrants that this system will be in and determine what our WINDOW should be.

Do we need to create a coordinate grid with all four quadrants? What quadrant will be graphing in? Why?

- No, we only need Q1 because we cannot have negative hats or negative cost.

1. **[Y=] Enter the equations on the calculator.**
2. **[WINDOW] Set the min and max values: Xmin=(0); Xmax=(60); Ymin=(0); Ymax=(60).**
3. **[GRAPH] Graph the equations.**
4. **Use CALC to display the point of intersection.**
    a. **[2nd] [CALC][5][ENTER] to select 5:Intersect from the Calculate menu.**
    b. **First curve? [ENTER] Second curve? [ENTER] Guess? [ENTER] (we only have two functions and one intersection point so we can just press [ENTER] without specifying the curves and int. pt.**
5. **What is the intersection point?** *(5, 45)*

**Look Back**

If we didn't have a calculator to calculate this, how would we verify that (5, 45) is the solution to the system?

IF TIME PERMITS: Let's do that for practice.

- Plug the x and y values into each equation to see if they make both equations true.

✓ $45 = 5(5) + 20$

✓ $45 = 6(5) + 15$

Let's look at this ordered pair in terms of our problem.

- For how many hats will the cost be the same for both companies?
  *The cost of buying 5 hats from Hats Off is $45.*
- What is that cost?
  *The cost of buying 5 hats from Top Stuff is $45.*

**Think about this question tonight and we'll talk about it tomorrow:**

**When is it cheaper for the baseball team to use Top Stuff and when is it cheaper to use Hats Off?**

## Closing/Homework

**10 minutes, 45 minutes**

Exit Ticket

Solve by graphing.

$$\begin{cases} x = 2y - 4 \\ x + 8y = 16 \end{cases}$$

Homework

6-1 Practice C