LESSON 19: Graphing a Line Given Slope and $y$-intercept

[Objective]
The student will graph a line given the slope and $y$-intercept.

[Materials]
Student pages S160–S169
Transparencies T484, T486, T488, T490, T492, T494, T496
Wall-size four quadrant grid (optional)
Calculators
Ruler
Piece of graph paper for foldable (one for each student)
Scissors
Copy Master of foldable

[Essential Questions]
1. What is the $y$-intercept of a line?
2. Where are the slope and $y$-intercept of a line located in the equation for the line?
3. Explain the steps for graphing a line if you know the slope and the $y$-intercept.

[Words For Word Wall]
slope, $y$-intercept, slope-intercept form, $y = mx + b$

[Grouping]
Cooperative Pairs (CP), Whole Group (WG), Individual (I)

[Levels of Teacher Support]
Modeling (M), Guided Practice (GP), Independent Practice (IP)

[Multiple Representations]
SOLVE, Verbal Description, Algebraic Formula, Graph

[Warm-Up] (5 minutes – IP, WG, I) S160 (Answers on T483.)
- Have students turn to S160 in their books to begin the Warm-Up. Students will identify the slopes of lines. Monitor students to see if any of them need help during the Warm-Up. Give students 4 minutes to complete the problems and then spend 1 minute reviewing the answers as a class. {Algebraic Formula}

[Homework] (5 minutes)
Take time to go over the homework from the previous night.
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---------Day 1 Identifying and Graphing with Slope and $y$-intercept---------

**SOLVE Problem** (2 minutes – GP, WG) T484, S161 (Answers on T485.)

Have students turn to S161 in their books, and place T484 on the overhead. The first problem is a SOLVE problem. You are only going to complete the S step with students at this point. Tell students that during the lesson they will learn how to graph a line using the slope and $y$-intercept. They will use this knowledge to complete this SOLVE problem at the end of the lesson. {SOLVE}

**Identify Slope and $y$-intercept** (10 minutes – M, GP, WG) T484, T486, S161, S162 (Answers on T485, T487.)

Use the following activity to help students complete the steps on S161 and S162. {Graph, Algebraic Formula, Verbal Description}
**LESSON 19: Graphing a Line Given Slope and y-intercept**

**MODELING**

**Identifying Slope and y-intercept**

**Step 1:** Ask students if they have ever heard of a football being intercepted. If so, ask them what that means. If students do not come up with the correct meaning, explain that intercepting the ball in football is when someone who was not supposed to catch the football catches it.

**Step 2:** Explain to students that in math, when a line crosses one of the axes on the coordinate grid, we say that the line has intercepted the axis. Ask, “If we are going to talk about the \( y \)-intercept, what axis do you think the line crosses?” (\( y \)-axis)

**Step 3:** Have students look at the equation in 3A and tell them that they will use the equation to fill in the function table. Work with students to find the \( y \)-values by multiplying the \( x \)-values by 3. Then graph the five ordered pairs and draw the line.

\[
y = 3x
\]

<table>
<thead>
<tr>
<th>( x )</th>
<th>( 3x )</th>
<th>( y )</th>
</tr>
</thead>
<tbody>
<tr>
<td>(-2)</td>
<td>3((-2))</td>
<td>(-6)</td>
</tr>
<tr>
<td>(-1)</td>
<td>3((-1))</td>
<td>(-3)</td>
</tr>
<tr>
<td>(0)</td>
<td>3((0))</td>
<td>0</td>
</tr>
<tr>
<td>(1)</td>
<td>3((1))</td>
<td>3</td>
</tr>
<tr>
<td>(2)</td>
<td>3((2))</td>
<td>6</td>
</tr>
</tbody>
</table>

Review the equation for slope, and use two points to find the slope as a class.

Example: (0, 0) and (1, 3) \[ m = \frac{\text{rise}}{\text{run}} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{3 - 0}{1 - 0} = \frac{3}{1} = 3 \]

Ask students what point the line crosses the \( y \)-axis at (0, 0). Explain to students that when the line crosses the \( y \)-axis, the \( x \)-value will always be 0. Explain that the \( y \)-coordinate gives the y-intercept, so the y-intercept in this example is 0.
Step 4: Have students turn to S162 in their books, and place T486 on the overhead. Use the equation in 4A to complete the table and graph the line.

\[ y = 3x - 1 \]

<table>
<thead>
<tr>
<th>x</th>
<th>3x - 1</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1</td>
<td>3(-1) - 1</td>
<td>-4</td>
</tr>
<tr>
<td>0</td>
<td>3(0) - 1</td>
<td>-1</td>
</tr>
<tr>
<td>1</td>
<td>3(1) - 1</td>
<td>2</td>
</tr>
</tbody>
</table>

Again, review the equation for slope and use two points to find the slope as a class.

Example: \((0, -1)\) and \((1, 2)\)
\[
m = \frac{\text{rise}}{\text{run}} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{2 - (-1)}{1 - 0} = \frac{3}{1} = 3
\]

Ask students what point the line crosses the \(y\)-axis at \((0, -1)\). Remind students that when the line crosses the \(y\)-axis, the \(x\)-value will always be 0. Explain that the \(y\)-coordinate gives the \(y\)-intercept, so the \(y\)-intercept is \(-1\).

Identify Slope and \(y\)-intercept – Practice (10 minutes – CP, I, WG) T486, S162 (Answers on T487.)

Have students complete 4B and 4C on S162 with partners. Circulate and make sure that students are following the same procedures from 4A. After 7 minutes, go over the two problems as a class. \{Graph, Algebraic Formula, Verbal Description\}

Identify Slope and \(y\)-intercept in an Equation (11 minutes – GP, I, WG, CP) T488, S163 (Answers on T489.)

Have students turn to S163 in their books, and place T488 on the overhead. Help students fill in the tables. \{Algebraic Formula, Verbal Description\}

First Table – Help students transfer the equations, slopes, and \(y\)-intercepts from Problems 3 and 4 on S161 and S162 into the table on S163.

Have students look at the next table. Tell them that they will be able to tell the slope and \(y\)-intercept of a line just by looking at the equation. Ask them to look at the slopes in the first table. Ask, “What do you notice about each slope and the equation?” (The slope is the same as the coefficient for \(x\).) Ask volunteers to write the slope of each of the equations in the second table.
Ask students to look at the $y$-intercepts in the first table. Ask, “What do you notice about each $y$-intercept and the equation?” (The $y$-intercept is the same as the constant. Or it’s zero if there is no constant.) Ask volunteers to write the $y$-intercept of each of the equations in the second table.

Complete the paragraph with students. Stress that $y = mx + b$ is called **slope-intercept form**, because the slope ($m$) is the coefficient of the $x$, and the $y$-intercept ($b$) is the constant.

Give students 2 minutes to work with their partner and find the slopes and $y$-intercepts of the equations at the bottom of the page. Use 1 minute to review the answers.

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**Graph a Line Given Slope and $y$-intercept** (17 minutes – M, GP, WG) T490, S164 (Answers on T491.)

Have students turn to S164 in their books, and place T490 on the overhead. Use the following activity to model for students how to graph lines with equations given in slope-intercept form.  

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**MODELING**

**Graphing Lines Using** $y = mx + b$

**Step 1:** Ask students to identify the slope of the line described by the equation in Problem A (2). Point out to students that the equation is in slope-intercept form, so the coefficient of the $x$ is the slope. Also remind students that slope is the rise over the run. Have students write the slope as a ratio: $\frac{2}{1}$, for a rise of 2 and a run of 1.

**Step 2:** Ask students to identify the $y$-intercept of the line described by the equation in Problem A (2). Point out to students that the $y$-intercept is represented by the constant when an equation is in slope-intercept form.
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**Step 3:** Work with students to graph the line, starting with the \( y \)-intercept. Ask students what the point is where the line crosses the \( y \)-axis (0, 2). Graph the point. Explain that students will start at this point and use the slope to find other points on the line.

![Graph of line with y-intercept at (0, 2)](image)

**Step 4:** Since the slope is \( \frac{2}{1} = \frac{\text{rise}}{\text{run}} \), put your finger on the \( y \)-intercept, model moving up 2 and over 1, and draw a point at (1, 4). Then go up 2 and over 1 again and draw a point at (2, 6). Point out to students that this makes a staircase of points which can be connected to make a straight line. Have students label the rise and the run of one of the steps.

![Graph of line with rise and run labeled](image)

**Step 5:** Repeat Steps 1–4 for Problems B, C, and D. For B, point out that the slope is already in \( \frac{\text{rise}}{\text{run}} \) form. Also point out that the minus sign before the \( y \)-intercept means that the \( y \)-intercept is negative. In C, students may have trouble with the negative slope. Remind students that when a variable is by itself, it has an understood coefficient of 1 (\( x = 1x \), and \( -x = -1x \)). Explain that a rise of \( -1 \) is the same as going down one unit. Remind them that in the last lesson they learned that the line went down from left to right if the slope was negative.
Have students turn to S165 in their books, and place T492 on the overhead. Use the following activity to model how to identify and write equations describing horizontal and vertical lines.

**MODELING**

**Horizontal and Vertical Lines**

**Step 1:** Ask students to write ordered pairs to locate any four points on the horizontal line at the top of the page. Four are listed on T493. Ask students how the points are similar or the same. (All the $y$-coordinates are 4.)

**Step 2:** Have students pick two of the points from the line and find the slope of the line using the formula.

Example: $(0, 4)$ and $(1, 4)$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4 - 4}{1 - 0} = \frac{0}{1} = 0$$

Explain to students that the line does not rise or fall from left to right. It stays flat; therefore, the slope is 0.

**Step 3:** Remind students that the $y$-intercept is where the line crosses the $y$-axis. Ask students what the $y$-intercept of the horizontal line is (4).

**Step 4:** Help students use the slope and $y$-intercept to write the equation of the line in slope-intercept form: $y = mx + b$. The equation should be $y = 0x + 4$. Explain to students that since 0 multiplied by any number is 0, the equation can be written as $y = 4$. Also point out that for every point on the line, the $y$-coordinate is 4, no matter what the $x$-coordinate is.

**Step 5:** Fill in the blanks in the paragraph about horizontal lines with students.

**Step 6:** Ask students to write ordered pairs to locate any four points on the vertical line at the bottom of the page. Four are listed on T493. Ask students how the points are similar or the same. (All the $x$-coordinates are 1.)
**Step 7:** Have students pick two of the points from the line and find the slope of the line using the formula.

\[ m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{2 - 3}{1 - 1} = \frac{-1}{0} = \text{undefined} \]

Explain to students that the slope is undefined because it is impossible to divide by zero.

**Step 8:** Remind students that the y-intercept is where the line crosses the y-axis. Ask students what the y-intercept of the vertical line is. (It does not cross the y-axis, so there is no y-intercept.)

**Step 9:** Explain to students that since the slope is undefined and no y-intercept, the equation will not be written in slope-intercept form. Remind them that for the horizontal line, when \( y \) was always 4, the equation was \( y = 4 \). In a vertical line, since the x-coordinate is always the same, the equation will be written as \( x = \text{a number} \). In this case, \( x = 1 \).

**Step 10:** Fill in the blanks in the paragraph about vertical lines with students.

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**Foldable**

** MODELING **

**Foldable**

**Step 1:** Put the paper flat on the desk, horizontally. Fold the top down, so that the piece on the desk is a little longer than the piece on the top. Make copies of the Copy Master of the foldable for the students.
Step 2: Fold the paper from left to right, into thirds. Cut along the dotted lines only, to make three sections on the top. On the first section on the left, write “Slope and y-intercept.” The other two sections will be blank to fill in during the next two lessons.

| Slope and  
y-intercept |
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

Step 3: Lift the flap, and write the steps for graphing a line if you know the slope and y-intercept.

Slope intercept form
\[ y = 3x + 2 \]
slope y-intercept
Steps:
1. Graph the y-intercept (0, 2)
2. Use the slope to rise (3) and run (1) to next point.

Step 4: On the top flap, graph the line.

Slope intercept form
\[ y = 3x + 2 \]
slope y-intercept
Steps:
1. Graph the y-intercept (0, 2)
2. Use the slope to rise (3) and run (1) to next point.
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Graph Lines Given Slope and y-intercept – Practice  (15 minutes – IP, CP, WG) T494, S166 (Answers on T495.)

Have students work with a partner to graph the lines of the equations on S166 (T494). After 10 minutes, go over their work together as a class. {Algebraic Formula, Verbal Description, Graph, Graphic Organizer}

SOLVE Problem  (5 minutes – GP, WG) T496, S167 (Answers on T497.)

Have students turn to S167 in their books, and place T496 on the overhead. Remind students that the SOLVE problem is the same one from the beginning of the lesson. Complete the SOLVE problem with your students. Ask them for possible connections from the SOLVE problem to the lesson. (Students should say that they need to graph the line using the slope and y-intercept.) Do not extend the line to go to the negative x-values because a dog can not have negative weight. {SOLVE, Algebraic Formula, Verbal Description}

If time permits...  (10 minutes – GP, IP, CP) S168 (Answers on T498.)

Have students turn to S168 in their books. For Problem 1, have each partner write an equation in slope-intercept form, but not graph it. For Problem 2, have each partner graph two points and connect them, but not write an equation. Have students trade papers with a partner, and have the partner graph the equation in Problem 1 and write an equation for Problem 2. Have partners check each other’s work. Circulate through the room to make sure partners agree on the equations and graphs. {Algebraic Formula, Graph}

[CLOSURE] (3 minutes)

To wrap up the lesson, go back to the essential questions and discuss them with students.

- What is the y-intercept of a line? (The y-coordinate of the point where the line crosses the y-axis.)
- Where are the slope and y-intercept of a line located in the equation for the line? (When an equation is in slope-intercept form, y = mx + b, the slope is the number in front of x, (m), and the y-intercept is the constant, b.)
- Explain the steps for graphing a line if you know the slope and the y-intercept. (Plot a point at [0, y-intercept]. Use the slope to rise and run from the point you made to plot the next point. Connect the two points.)

[HOMWORK] Assign S169 for homework. (Answers on T499.)

[QUIZ ANSWERS] T500–T503

The quiz can be used at any time as extra homework or to see how students did on understanding how to graph a line given the slope and y-intercept.